VOL. XXVII. — No. 5. MAY 1950.

Monthly Bulletin of the International Railway Congress Association

(English Edition)

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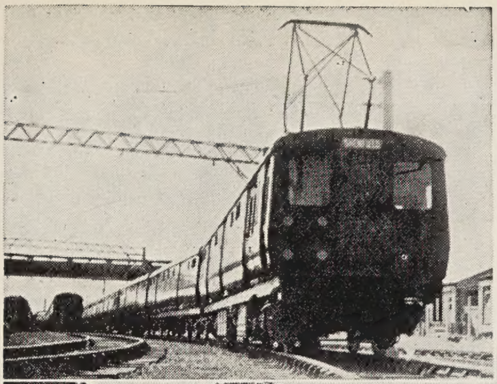

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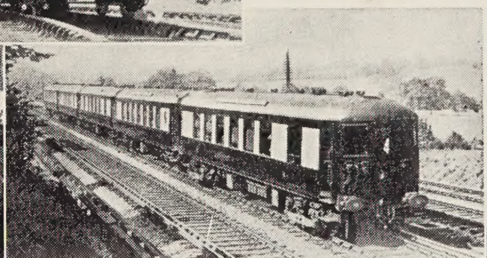

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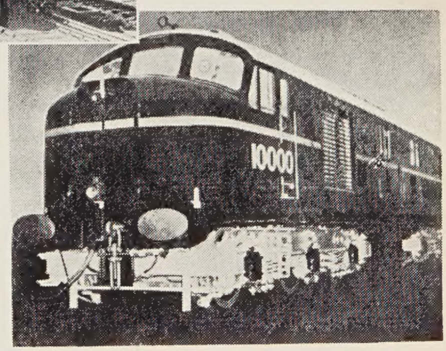

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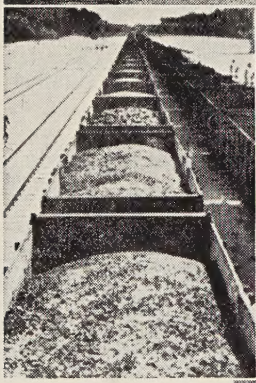

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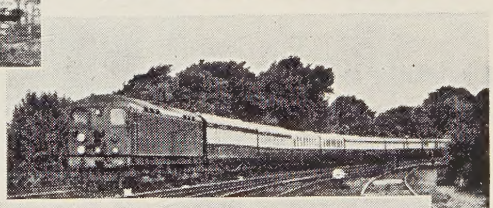

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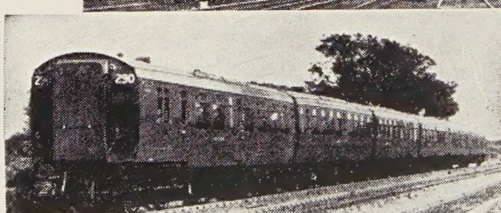

8

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VACUUM BRAKES
ELECTRO-PNEUMATIC BRAKES

●

1 Self-lapping electro-pneumatic.
2 Automatic Air.
3 Vacuum Brake with Air Equipment.
4 Straight Air with Emergency.
5 Lu Type Automatic for empty-load, passenger-freight.
6 6 E. T. Locomotive brake for passenger, freight or shunting.
7 Air and vacuum for electric locomotives for passenger or goods.
8 Automatic vacuum.

Photos. by Courtesy of British Railways, Eastern Region (1), Southern Region (2, 7, 8), Midland Region (3), Polish State Railways (5), Hunslet Engine Co. Ltd. (4), South Australian Govt. Rlys. (6).

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SEVENTY-FOUR YEARS OF BRAKING

Alphabetical Index of Advertisers

Bulletin of the International Railway Congress Association

CONTENTS OF THE NUMBER FOR MAY 1950

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BULLETIN
OF THE
INTERNATIONAL RAILWAY CONGRESS
ASSOCIATION
(ENGLISH EDITION)

[656 .225 & 656 .261]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

15th. SESSION (ROME, 1950).

QUESTION VIII.

In view of the ever increasing weight of road competition, what are the most appropriate measures, apart from reduced rates, for keeping traffic by full wagon loads in the hands of the railway ?

Would not road transport at the end of the railway journey be justified in order to get direct contact with clients who are not connected up by railway sidings ?

Should not the road vehicles required to assure such transport be attached to central stations, equipped with suitable handling equipment, from which the road transport services would start ?

Choice of the vehicles to be used.

REPORT

(America (North and South), Burma, China, Costa Rica, Egypt, Great Britain, North Ireland, Dominions, Protectorates and Colonies, India, Iraq, Iran, Malayan States, Pakistan.)

by A. A. HARRISON,
Executive Officer (Road Transport), British Railways.

INTRODUCTION

Information on this subject was received from :

- British Railways;
- the South African Railways;
- the New Zealand Railways;
- the Indian Railways;
- the Pennsylvania Railroad Co.;
- the Sudan Railways;
- the Victorian Railways;
- the Egyptian State Railways.

The reporter wishes to acknowledge with thanks the help he has derived from this information and also the assistance given to him by his colleagues in Great Britain.

The measures taken, or which can be taken, may be grouped under three heads :

- Service.
- Protection by statutory limitation of road competition.
- Integration of transport facilities through State ownership or control of rail and road undertakings.

SERVICE.

1st PART.

A. Terminal transport of full wagon loads at all stations.

This report is concerned with traffic in full wagon loads, as distinct from miscellaneous traffic which has been reported

upon in former years. Where railway administrations provide collection and delivery service, there is much common ground between full wagon loads and miscellaneous traffic in the type of equipment used, and in the general organisation of the service.

There is divergence of practice in the provision of road transport at the end of the railway journey for traffic in full wagon loads. The most comprehensive service of this kind is provided by the railway administrations in Great Britain and South Africa. In other countries, consignees are, in the main, required to make their own arrangements for removing such traffic from the railway stations. This radical difference affects much of the report.

Competition by road transport experienced by the Victorian Railways is mainly directed to highly-rated traffic, such as less-than-wagon-load general merchandise, together with fruit and timber. The bulk of the wagon load traffic consists of agricultural produce, fuel, and fertilisers, the rail rates for which are on such a low basis that, generally speaking, the use of road transport is not economical. Goods transport by road, in quantities that would provide wagon-load rail traffic, consists principally of fruit, which is hauled direct from orchards to metropolitan markets, or log and sawn timber from forest to sawmills which, in most instances, are remote from the railway.

In other countries, the competition appears to be more general.

Rail transit cannot compete successfully with road transit unless it either affords a comparable door-to-door service, or induces the trader to accept a station-to-station service only.

There is not the same objection to the consignor or consignee using his own vehicles, or those of his agent, for the cartage of full wagon loads, as there is for miscellaneous traffic. Full wagon load traffic is usually loaded, or unloaded, at places in the depot where the presence of individual trader's vehicles, or the vehicles of their agents, is not likely to cause intolerable congestion. There is, therefore, something to be said for encouraging traders to cart their own traffic through rate adjustment, or allowance of rebate, thus avoiding capital outlay on railway-owned cartage equipment, and the risk of unremunerative operations. On the other hand, it is much easier to cart full-wagon load traffic remuneratively, than it is to cart miscellaneous traffic, and if an establishment is maintained for one, it can be used in part for the other.

Organisation and Method.

There is no general distinction on British Railways or on the South African Railways between miscellaneous traffic and full wagon load traffic in the provision of cartage service. Whether or not cartage is undertaken is dependent upon commodity classification and not upon size of consignment.

Goods on British Railways are at present grouped into 21 classes, largely on a basis of value, loadability, and vulnerability to theft and damage. Traffic in the lower classes, viz. 1 to 10, is only carted by special arrangement. Rates for classes 1 to 10 usually cover conveyance from station to station only, while those for classes 11 to 20 include collection and delivery as a normal feature. Traffic in class 21, is carted only on special terms.

Delivery of all traffic carried by railway at rates including delivery is undertaken on British Railways and on South African Railways as a matter of course, except that in Great Britain the consignee may elect to make his own cartage arrangements, and claim a cartage rebate.

The client in Great Britain may elect to provide his own cartage for all or any part of his traffic, but the South African client is not relieved of cartage charges if he chooses to cart the traffic himself. Where traffic is carried at station to station rate on British Railways, the consignee is advised of its arrival so that he can, if he wishes, ask the railway organisation to deliver the traffic. Station to station traffic

is not carted by South African Railways at all.

Although traffic in classes 1 to 10 is only carted on British Railways by special arrangement, large quantities of such traffic are so carted, particularly in the country districts. The cartage service for full wagon loads, so provided, preceded the railhead or zonal collection and delivery service afterwards provided for less-than-wagon-load traffic.

The cartage organisation covers most goods stations on British Railways, and at 124 of the South African Railway stations. On British Railways the bulk of the work is done by railway-owned staff and equipment. The same is true at 10 of the South African Railway stations. At the remainder, the work is done by contractors, who are appointed following the invitation of public tenders for five-year contracts.

The vehicle establishment is matched to local requirements. At the smaller stations on British Railways the local establishment is supplemented by assistance from nearby larger stations. Full wagon loads usually provide full cart loads, and the extra cost of longer hauls by road from a central station would not be offset by savings on shorter rail hauls, or on traffic concentration, unless it were possible to close the small station altogether. Under the new circumstances created by the Transport Act, 1947, the cartage establishment operated by British Railways is gradually being reduced to the minimum required to deal with normal traffic, the resources of the nationalised British Road Services being drawn upon for marginal and seasonal requirements.

At the larger stations on British Railways, it is usual to distinguish in part between vehicles supplied for full wagon load traffic, and those supplied for less-than-wagon-load traffic, but at the smaller stations the vehicles are generally required to cart both types of traffic. Less-than-wagon-load traffic usually needs articulated vehicles for advance loading purposes whereas wagon load traffic can sometimes be carted efficiently by rigid vehicles. The vehicles employed on wagon load cartage also tend to be of higher weight capacity.

The Pennsylvania Railroad only provides a cartage service for full wagon loads in New York City. The work is done by a contractor who is paid the tariff charges received from the client by the Railroad for the service. The service is not obligatory on the client. Results are favourable. Clients like the service and it is well patronised.

Neither the New Zealand nor the Indian Railways undertake the cartage of full wagon loads, nor do the Indian Railways contemplate doing so. The New Zealand Railways have recognised the need for something of the kind by reimbursing clients with the approximate cost of employing local carriers to deliver the higher rated goods which are susceptible to road competition. The rebate is also made to clients who take delivery of their own goods. The system is applied only at 23 of the larger provincial centres where competition is keen, and covers some 70 000 tons a year. There is no contract between the Railway and the local carrier. The system is holding traffic, and has recovered traffic in quite a number of cases.

In New Zealand there is an insistent and growing demand for door-to-door delivery of goods, particularly those of an urgent or perishable nature, but the railway administration has entered into an understanding with the New Zealand Road Transport Alliance, whereby the Railway will not undertake town delivery work, provided the road operators will not seek licences to operate route services in competition with rail.

It is recognised that the system has the disadvantage of giving the Railway no control over the carrier, and no power to regulate the delivery of traffic so as to prevent delays. The Administration feels that the provision of its own terminal transport would reduce the overall time a consignment is in transit, and improve the competitive position of the Railway. Transit

time is one of the main reasons why traffic is diverted to road.

During the year 1948, the railway-owned cartage establishment in Great Britain, consisting of some 12 000 motor vehicles and 8 000 horses, with their complement of trailers and drays, carted some 28 million tons of goods traffic. This represents little more than 10 % of the total tonnage of all traffic conveyed by railway, but it should be noted that the bulk of traffic in the lower classes is not normally carted by the railway, and large tonnages are forwarded to or from private sidings. A further 3 million tons were carted by regular cartage contractors, mainly in Scotland and the Midlands, and nearly one million tons by contractors hired occasionally. A growing proportion of the contracted work is being undertaken by British Road Services.

The work of the regular contractors is undertaken on the basis of a formal agreement, and is usually paid for at so much per ton. Occasional hiring is either on a tonnage or a time and mileage basis.

Cartage is one of the functional responsibilities of the commercial Member of the Railway Executive in Great Britain. One of his Executive Officers assists him in discharging this function, and is Chairman of a Committee comprising the regional Cartage Officers, who assist the regional Commercial Superintendents. The District commercial officers have cartage assistants. The station agents include Cartage Supervisors among their staff. Day to day operations are controlled through the regional organisation, but the cartage Committee mentioned above meets every month, and is the agency through which policy filters down, practices and equipment are standardised, vehicle programmes are prepared, working results are reviewed, new ideas are promoted, and the fruits of experience are pooled.

The principal instrument of control is a statistical one. 4-weekly statistics record at station, district, regional and headquarters level, all the essential particulars of tonnage, mileage, and costs, but no distinction is drawn in these statistics, detailed though they are, between full wagon loads and other traffic. There is a distinction between goods and parcels.

The place of collection or delivery at client's premises is the usual place for loading or unloading merchandise. British Railways are under no obligation to provide any labour additional to that of their motor driver or carter which may be required for loading or unloading at such premises. Motor drivers or carters may perform additional services provided there is no undue risk of personal injury, damage to equipment, or undue loss of time. In some cases, such as cellaring of ale, additional charges are raised for the service. The service of cartage is regarded as inclusive of loading or unloading at the railway station, which is manually performed in the main, although increasing use is being made of mechanical appliances, such as conveyors, elevators and fork lift trucks.

In South Africa, the client is required to undertake the removal from or loading on to railway-owned cartage vehicles.

Charges.

Where the railway rate in Great Britain does not include cartage, a charge for the service is usually raised according to fixed scales, the scale applicable at any particular station being determined by local circumstances and traffic density. The following scale is most widely applied :

Classes.	*Rate per ton.* *s. d.*
11 — 16	4. 2
17 — 18	5. 5
19 — 20	6. 10

Somewhat lower rates are applied, as a rule, to traffic in classes 1 — 10 if cartage is undertaken. Where these are not scale charges, they are based on the cost of the service, plus a margin for profit. Special charges are raised for heavy haulage and positioning of abnormal articles.

Types of vehicles.

Horses and drays are still being used in some of the larger towns in Great Britain, but are being replaced by mechanical units as fast as staff can be absorbed and the equipment obtained. Various kinds of motor vehicles are being used, but the tendency is for articulated equipment to be preferred to rigid vehicles, except where the lower manoeuvrability of 6-wheeled articulated vehicles is inconvenient. The range of vehicles mainly employed is shewn below :

Articulated type. — Mechanical horses (3 wheelers) hauling 2-wheeled superimposed trailers of 30-cwt., 3-ton, and 6-ton capacity.

4-wheeled motive units hauling 2-wheeled trailers of 3-ton to 8-ton capacity.

Trailer bodies have similar characteristics to the bodies of rigid motors.

Rigid type. — Capacities vary from 1 to 12-tons falling mostly in the 2 — 8 ton group. The lorries are 4 or 6-wheeled.

The bodies range from the flat platform type, to those with fixed or hinged sides, or sides and roofs. Most of the vehicles are of general utility type, but some are specially constructed for abnormal loads.

Tractors. — These are 4-wheeled units for hauling trailers with 4 or more wheels, having capacities varying from 6 to 25 tons. The trailer bodies are mainly of the flat platform type.

So far it has been more economical to employ rigid motors and motive units for articulated equipment, more or less as designed by the manufacturers for the general market, since vehicles specially designed for the peculiarities of railway cartage would lose the benefits of mass production. Trailer dimensions and design can be more closely associated with railway needs and standard dimensions and specifications are now being adopted.

Illustrations of typical vehicles employed on British Railways are given in Appendix « A ».

Heavy haulage.

A special service is provided for the cartage and placing or unplacing of abnormal indivisible loads, such as electrical transformers, boilers, tanks and heavy girders. The service is operated in part by railway staff and railway-owned equipment, and in part by co-operation with the heavy haulage division of British Road Services. The railway-owned equipment consists of high capacity tractors and trailers, the latter being of the low-loading type. Various kinds of tackle are used for transferring the loads from or to the cartage vehicle, many of which are beyond the capacity of a mobile crane.

Financial results.

Separate costs of carting full wagon load traffic on British Railways are not recorded, but whereas the revenue directly derived from cartage as a whole liquidates no more than two-thirds of the cost, it is safe to say that most of the deficiency occurs in carting less-than-wagon-load traffic. The extent to which the service of cartage as a whole is subsidised from British Railways receipts is shewn by the following figures for the year 1948 :

Working expenses . . .	£	12,377,882
Gross receipts	£	8,377,594
Deficit . .	£	4,000,288

Cartage is regarded as an ancillary service designed to attract traffic to the railway by offering a door-to-door transit, and the above figures reflect a situation which has long been accepted as a feature of British Railways practice.

The British Railways cartage service has been developed over very many years, and has been progressively modernised, but there is a continuing problem of ensuring that the location of vehicles, and the selection of type, is such as to ensure the most economical arrangements.

Reactions and benefits.

The provision of cartage service by the railways in Great Britain has long been accepted and appreciated by railway clients, and there can be no doubt that the expanded service in the country districts during the past 20 years has frequently enabled the railway to hold or recover traffic. Numerous examples can be cited, such as the collection of grain, fruit and vegetables, and the delivery of artificial fertilisers, feeding stuffs, seeds, water pipe and conduits. It will be noticed that reference is made to traffic in the lower classes for which cartage on British Railways has to be specially arranged. The cartage of traffic in the higher classes has been taken for granted for sixty years or more.

Road haulage firms in varying degrees, and at different periods, have sought employment by the railways for cartage work, and the restriction of independent road haulage in Great Britain to work within a 25 mile radius, in the absence of a permit for more extended operations, is liable to lead to increased pressure from independent road haulage firms for employment by the railway.

When the railways were expanding their cartage services in Great Britain, and had to obtain operating licences from the Licensing Authorities, they met with opposition from local carriers who coveted the work, but the Appeal Tribunal set up under the Road & Rail Traffic Act, 1933, gave decisions which had the effect of making it very difficult for Licensing Authorities to refuse licences to the former railway companies for the cartage of railborne traffic. Since the passing of the Transport Act, 1947, no operating licences have been necessary for British Railways.

B. Terminal transport of full wagon loads from certain central stations.

On British Railways the substitution of motors for horses has permitted some local concentration of cartage work, but any greater concentration has not been found advantageous.

Consideration has been given, for some years, to the possibility of closing intermediate stations on main lines and the complete, or partial closing of branch lines. Attention to this problem has been reinforced since nationalisation, and all branch lines of doubtful revenue earning value are being thoroughly examined and the possibility of substituting road service to and from a railhead on a main line considered. Certain branch lines which are self-supporting are also being examined with a view to establishing whether British Road Services could meet requirements more efficiently and economically to the advantage of the Commission's undertaking as a whole. A recurring difficulty is that of providing an economical substitute for throughout rail haulage of coal and similar traffic, bearing in mind the custom of storing such traffic at stations nearest to the ultimate purchaser.

Except in the case of containers, mentioned below, no cartage service is provided by the Egyptian State Railways. Clients are required to bring traffic to the main despatching station and take delivery of traffic at the main destination station. The provision of cartage service by the railways is not regarded as practicable, as in most cases the work can be done more cheaply by clients.

2nd PART.

A. Containers.

Types.

British Railways have found that for a large range of full-wagon load traffics, the expense of double handling can be avoided by the use of containers, which can be craned on and off railway wagons and cartage vehicles. Containers were first used experimentally in 1926. Particulars and illustrations of the types of containers in use are given in Appendix « B ». No information is available of actual tonnage

conveyed in containers, but during 1948, the user of the various types was as shewn below, and may be said to represent one million tons of traffic.

About 3 % of all wagons loaded with general merchandise contain traffic in containers.

The covered container is used for the more damageable or valuable types of merchandise, which would otherwise require much handling, or packing, such as:

Furniture. Groceries. Tinware.
Bicycles. Confectionery. Textiles.
China & Pottery. Boots & Shoes.

The open container is used for traffic less susceptible to theft or bad weather, such as:

Stoves. Baths. Slates.
Grates. Bricks. Stoneware.
Castings. Tiles.

1948 type	Max. load capacity Tons	Number of loaded journeys	Stock
Covered.			
A	2 1/2 — 3	114 619	3 943
AF	1 1/4 — 3 1/2	7 201	313
BD. BK	3 — 4	169 160	6 462
BC	4	4 971	286
Open.			
C	2 1/2 — 3	12 861	892
D	4	34 788	2 398
H	1 1/2 — 2	28 774	3 642
Meat.			
F. M.	3 — 4	54 790	2 834
B. M.	3 — 4	7 622	407
		Total 434 786	21 177

The use of containers is one of the most effective counters to road competition. The following are typical examples of traffics secured by these means:

Commodity	Places between		Annual tonnage
	From	To	
Cement	Rhoose	Rhayader	17 500
Clothes.	South Wales	London	800
Cycles	Nottingham and Birmingham	Various destinations	5 000
Refrigerated foods, (including ice cream) . . .	Mainly London	Various destinations	15 000
Confectionery	York	Various destinations	7 000
Tin scrap.	Hull	West Hartlepool	2 200
Bread	Newcastle	Carlisle	1 000
Fruit	Southampton docks	London	4 500

The dimensions of the large containers are such that only one unit can be loaded in a standard wagon. The small containers can be loaded 2 or 3 to a wagon, according to type, and every effort is made to maintain a full wagon load.

To discourage uneconomical user, a minimum charge, as for one ton per container, is levied in all cases.

Containers are not supplied by the South African Railways, nor by the Indian Railways.

The Pennsylvania Railroad operates 3 711 waterproof containers of the controlled flow type, with a capacity of 16 000 lbs. The dimensions are :

Length	7 feet.
Width	4 feet 3 ins.
Height	5 feet 3 ins.

They are used for bulk commodities, such as cement, lime, and furnace fluxing materials, requiring protection from the weather.

With few exceptions, the New Zealand Railways use containers only for the inter-island transport of household removals. They believe, however, that container user will develop rapidly in New Zealand. The administration intends to explore possibilities and develop them where it is advantageous to do so. It is felt that the future of the container will be one of progressive popularity, and that it will play a big part in retaining to rail various bulk and special traffics which are susceptible to road competition.

On the Egyptian State Railways, containers are used principally for furniture traffic. The containers are 7 ft. 4 ins. wide, by 12 ft. 9 ins. long by 8 ft. 3 ins. high, and each container has a capacity of approximately 2 tons. The cranage of containers and cartage from clients' premises to railway stations are provided by the railways, the cost being included in freight charges.

Privately-owned containers.

In view of their restricted availability and empty mileage, the extended use of privately-owned containers is not considered desirable by British Railways, or by the Pennsylvania Railroad, but it is permitted in Great Britain where the alternative is the loss of traffic to road transport.

A few traders use their own containers on the South African Railways.

Handling plant.

It has not been found necessary to invent handling plant of new design on British Railways to deal with containers. Standard cranes of stationary or mobile type, supplied by the railway, are used according to local circumstances. The railway and cartage charges are normally inclusive of the cost of cranage. The development of the container is adding to the importance of the crane. Where it is having to deal with large numbers of containers regularly throughout the day in one section of the station, an overhead gantry, spanning parallel wagon standages and roadways in between, is a useful form of equipment. For general utility purposes, the mobile crane is better. It is cheaper and more convenient, as a rule, to take the crane to the wagon than the wagon to the crane.

Cartage of containers.

The cartage of containers is usually undertaken by British Railways, although some clients arrange their own cartage. It is performed either by ordinary rigid motors with flat platform bodies, or on trailers drawn by rigid motors or articulated units. In many cases the trailer is left at the client's premises for the container to be loaded or unloaded. Stemni or Sulki equipment is not employed. The capacity and dimensions of containers are related to the use of standard cartage equipment. Much waste is involved if special vehicles have to be provided for container cartage. The essence of economical operations is the maximum interchangeability of equipment.

B. Wagon carrying trailers.

This type of equipment is not used by any of the Railways covered by this report. The expense and inconvenience of operation, compared with other methods of dealing with the problem, have so far ruled out the development of this method.

Its economical use is probably confined to the rare type of case in which private siding access is out of the question, but the traffic is regular and heavy enough to justify the full-time use of the costly equipment required. In Great Britain such equipment could only be worked under special dispensation from normal road traffic regulations.

C. Rail-Road trailers.

Road equipment.

These are not used on South African Railways or the Pennsylvania Railroad, nor on the Indian Railways. On British Railways such units are regularly used in small numbers for conveying liquids in bulk, such as milk, vinegar, beer, and oil. The units vary in capacity and design, some having 4-wheels, others only 2, on the superimposed articulated trailer principle. Special features, such as tank linings, insulation, heating and automatic pumps, have been incorporated to meet individual requirements. Particulars of typical 4-wheeled trailers in service are given below :

	Milk trailers	Beer trailers
Dimensions	19 feet 6 inches long 7 feet 6 inches wide	14 feet 6 inches long 7 feet 0 inches wide
Capacity	2 000 gallons	1 440 gallons
Unladen weight	5/6 tons	4/5 tons

The maximum permitted road speed for these trailers is 20 m.p.h.

It is usual for the trailer unit to be owned by the client. Where they are owned by British Railways, suitable hire charges are raised under contract for a minimum period of 5 years.

There are 120 trailer units in use with a capital value of £ 152 000 (inclusive of trailer and special rail wagon) and these units carry 100 000 tons a year.

The trailers are hauled on the road by tractors, the distance rarely exceeding 5 miles.

Rail equipment.

Special rail wagons are provided, fitted with guide plates to keep the trailers in position, and locking bars to prevent movement during rail transit. Inner wheels provided on the trailer unit engage on flanged rails on the floor of the rail chassis, thus taking the weight off pneumatic tyres during rail transit.

End-on loading docks are employed at the stations, the trailers being pulled on or off rail wagons by the road tractors.

Demountable non-wheeled equipment.

The alternative method of providing non-wheeled demountable tanks or other containers is generally encouraged by British Railways, thus avoiding the use of specially constructed rail wagons, the waste of capital assets in the shape of wheels, tyres, axles, brakes, springs, etc., which lie idle in the course of rail journeys. Door-to-door service is best given by combining the maximum use of ordinary cartage equipment with the use of containers and ordinary rail wagons. Every departure from the ordinary means the provision and maintenance of special and expensive gear, for which full employment may not be available.

Under the Transport Act of 1947, the road conveyance of liquids in bulk is free from restriction, and in view of this, British Railways need to counter competition for this traffic by the means described. Development is partly dependent upon the installation of bulk storage facilities by clients.

D. Other methods of liaison with the station.

Special equipment.

On British Railways, Indian Railways, and on the Pennsylvania Railroad, any special equipment for loading or unloading railway wagons at clients' premises is usually located at a private siding, and owned by the client, but there are cases where equipment is located at railway premises and provided by British Railways.

It is the practice at many stations to allocate a siding or portion of a siding to receive tank wagons loaded with motor spirit, or other hydro carbons. Standpipes are erected, coupled to pumps which syphon the liquids into the clients' storage tanks nearby. The pumps, etc., are owned and maintained by the clients, nominal charges being made for the right to instal on railway premises.

Conveyors.

There are a few overhead conveyor installations. One such conveys bales of wool from a railway warehouse to the clients' premises, the machinery being owned and maintained by the client, nominal charges being made for the right to support one end of the conveyor on railway property. Another carries bagged traffic from the client's warehouse and discharges it into rail wagons set in an adjacent station : the plant being provided, maintained and operated by the client. Another, installed by the railway, carries sacks of sugar from a warehouse, over the main line, into a shed for loading into rail wagon. Overhead wire rope conveyors are used by some clients for loading quarried stone into rail wagons.

Elevators.

A few British Railways warehouses have vertical or inclined elevators to take traffic in sacks from rail wagons to the upper floor of the warehouse, or to a client's tenancy. Some of the installations have conveyors to distribute the sacks to various storage areas. Spiral shutes are provided to deliver laden sacks to road or rail vehicles when taken out of stock. Suction elevators for discharge from railway wagons into warehouses are in an experimental stage. There are instances at private sidings where bulk traffics are discharged from hopper wagons direct to a client's belt conveyor, or bucket elevator.

The Pennsylvania Railroad operates grain elevators equipped with suction plants or conveyor belts for the unloading of grain from rail wagons to storage premises.

3rd PART.

A. Measures affecting transport conditions.

1. *The part played by speed.*

On British Railways freight train services are not divided into slow and fast with differing scales of charges therefore but clients wishing to obtain a faster service than that normally given by freight train, have the alternative, if the traffic is suitable, of sending it by passenger train at appropriate charges.

Express freight train services are provided between important centres, chiefly on main line routes, both for streams of ordinary traffic and also for particular classes of traffic, such as seasonal fruit and vegetables. No extra charge is made for these services.

For many years the policy in Great Britain has been to introduce new and accelerated express freight train services, with a minimum of staging so as to provide a next day delivery to the widest possible extent. Intensive road competition has spurred the development of this policy.

It is possible to maintain an average speed of 16 m.p.h. on the road. A road haulier can therefore give a door-to-door transit up to 50 miles or more within a day, and the driver can return to his base for the night. This sets a problem for the railway for traffic within this distance if it has to allow for a separate service of collection and delivery at each end. For

longer distances of, say 150/200 miles and over, it may be claimed that the railway has the advantage. It is for distances in between 50 and 150 miles that the railway must provide an overnight service with delivery the following morning if it is to hold or regain traffic on trunk routes.

Before 1939 the policy of extending express freight train services was being actively pursued, but during the war years it had to be discontinued. A post-war priority was the restoration of the pre-war services and the introduction of others. At the present time some 568 express freight train services are being run — more than in 1939 — typical examples of which are shewn in Appendix « C ».

In addition more than 1 000 other freight train services have been accelerated since the war, by as much as 2 hours or more.

The available number of vacuum brake fitted wagons is limited, and it is not therefore possible for all express freight trains to be run fully fitted. Certain classes of trains are therefore provided which run with only a proportion of fitted wagons. Recent wagon building programmes have provided for a higher proportion of fitted stock.

Express freight trains are divided into the following categories :—

Category (I). At least 50 % of wagons (next engine) are fully pipe fitted for vacuum brake and close coupled. Average speed : 45 miles per hour.

Category (II). One-third of wagons (next engine) are fully pipe fitted for vacuum brake and close coupled. Average speed : 35 miles per hour.

Category (III). Approximately one-fifth of wagons (next engine) are fully pipe fitted for vacuum brake and close coupled. Average speed : 30 miles per hour.

Category (IV). Not fitted for vacuum brake but limited to 45 wagons. Average speed : 25 miles per hour.

In New Zealand express freight services are provided for long-distance traffic. The longest of these is between Auckland and Wellington, a distance of 426 miles, the express service taking half the time of the ordinary through freight train service. The express services are extensively used for perishable traffic, although the bulk of the traffic so carried is of a general nature. No additional charges are raised. Freight transport has been speeded up generally by the provision of direct or through train services aiming at the avoidance of staging.

The Indian Railways have introduced express freight services between certain important stations for perishable traffic, no extra charge being raised.

On the Pennsylvania Railroad freight traffic is divided into slow and fast, the choice being left to the consignor, who pays charges accordingly. Scheduled services are provided for perishable traffic as compared with slow freight operations which are based on the day-to-day availability of traffic.

The Victorian Railways recognise that the provision of fast and dependable rail service is an effective way of conserving the higher grade traffic to rail.

On the Egyptian State Railways, cattle and perishable traffic are systematically carried by fast freight trains with no increase in charge. Full wagon load traffic is conveyed on through trains from the despatching station to the furthest point in the direction of destination. Pick-up trains are only used for the shortest possible distance.

2. *Regularity of Transport Time.*

The extension of express freight train services on British Railways has resulted in a reduction in theoretical transit times, and these scheduled times, together with the actual performances, are constantly being reviewed in order to improve punctuality.

There is no arrangement under which freight transit times shorter than normal are guaranteed.

Consequent upon the nationalisation of British Railways a complete review of routes is being made in order to route traffic more directly, and to eliminate du-

plicate and circuitous routing. This, besides speeding transits, will enable flows of traffic hitherto passing over alternative routes to be merged, thus securing economic block loads of traffic for long distance destinations.

It is not the general practice to give clients advance warning of the arrival of wagons except in certain cases where livestock or perishable traffic are concerned.

In New Zealand the pressure of road competition has brought about reduced transit time, and it is proposed to further improvement by a planned programme of co-ordination and continued revision of the work performed by individual trains.

The Pennsylvania Railroad reports a reduction of theoretical transit time as the result of competition.

Both in Pennsylvania and New Zealand clients are warned of the arrival of wagons, and these preliminary warnings are valued. The Pennsylvania Railroad uses a system of passing reports indicating the movement of the specific traffic.

The New Zealand Railways send on the invoice in advance of the traffic, and when the invoice is received at the destination station, the consignee is given particulars of the consignment, and of the train by which it will arrive. In the case of freight forwarded by express train, the invoice particulars are teleprinted, and are in the hands of the receiving station before the freight leaves the forwarding station.

On the Egyptian State Railways, improved transit time is hampered by the deferred renewal and maintenance of track and rolling stock during the war, but maintenance and renewal programmes are being pushed forward, and improvement schemes are in hand for quadrupling track, providing avoiding lines, improving signalling, and extending traffic control over congested sections.

3. *Use of privately-owned wagons.*

As a general principle, all railway wagons in Great Britain became the property of British Railways under the Transport Act, 1947. There are exceptions in the case of wagons for traffics liable to cause contamination, or requiring special conditions, e.g. iron oxide waste, nitre cake, salt, tarred material, cement, and motor spirit. Train ferry service wagons to and from the Continent of Europe are also an exception.

Where the client provides his own wagons he is normally given the benefit of an owners' wagon rate.

The use of privately-owned wagons is not allowed on Indian Railways.

The only privately-owned wagons in New Zealand are tank wagons conveying petrol in bulk.

On the Egyptian State Railways, apart from a limited number of wagons exclusively used for the carriage of military stores, no privately-owned wagons are used. The privately-owned wagon is not encouraged.

4. *Use of special type wagons.*

Most of the Railways which have supplied information for this report, provide special wagons for exceptional traffics. British Railways, for example, have special stock as described below :

	Total stock.
a) Refrigerated vans for frozen meat, etc.	1 600
b) Ventilated vans for fresh meat, etc.	1 115
c) Banana vans (steam heated) .	3 530
d) Iron ore wagons (fitted with hopper discharge)	13 072
e) Soda ash wagons (fitted with hopper discharge)	90
f) Bulk grain wagons (fitted with hopper discharge)	533
g) Roadstone wagons (fitted with skips for discharge by cranage and rotation)	100

High capacity wagons of the well type are also supplied for the conveyance of abnormal indivisible loads up to 150 tons, such as heavy ingots, electrical stators, large boilers and tanks. The South African Rail-

ways provide special wagons for dangerous liquids, such as petrol, power-paraffin, ammonia and acids conveyed in bulk.

The Pennsylvania Railroad attaches considerable importance to the use of special type wagons to retain traffic. They provide automobile wagons, equipped with automatic loading devices, and special type door ends to facilitate loading and unloading. They supply self-clearing hopper wagons and well wagons for the conveyance of fabricated structures of abnormal height. They also supply refrigerated cars and tank cars for the conveyance of liquids in bulk.

On the Egyptian State Railways, a certain number of special type wagons are provided as follows :

Refrigerators; Petrol, Benzine & Asphalt Tanks; Tanks for carriage of molasses, oils; Wagons for carriage of heavy machinery.

B. Station facilities.

The provision of space and buildings for storage has long been a valuable asset to many railway administrations in attracting and retaining traffic.

Manufacturers are not always able to dispose of their manufactures as rapidly as they are made, and are unable to hold them at the factory. This problem has arisen in Great Britain in consequence of the export drive, storage space not always being available either at the factory or at the port. The railways have been able to supply the need.

Storage.

The need for storage is even greater after transit, especially if the trader wishes to consign in bulk to obtain the benefit of a cheaper rate, and to break bulk for distribution. An example of the type of case where breaking of bulk is not involved is that of wool imports in Great Britain. Very large quantities of wool are railed from the ports to Yorkshire, where they are put in well-equipped railway warehouses until required by the manufacturers.

Breaking of bulk is a large scale operation in Great Britain for such traffic as confectionery, tobacco, soap, groceries, etc.

British Railways have developed a system of railhead distribution whereby clients are encouraged to concentrate traffic for specified areas on a selected centre. Under this method clients are able to make up wagon loads direct to the railhead, thus reducing transit time and avoiding transhipment, besides obtaining the benefit of cheaper bulk rates. In each case, the trader has the option of employing his own staff at the railhead to receive and execute orders, or he may entrust the whole process of warehousing, stock recording, distribution, and associated services for British Railways to perform on agreed terms.

It is not the general practice on British Railways to acquire industrial sites alongside stations in order to rent them to railway clients, but the following facilities are extensively offered :

Uncovered accommodation.

Wharfage space adjacent to sidings in goods and coal depots, for the storage of commodities not requiring protection from the weather, e.g. coal, builders materials, and road materials.

Short term agreements for a minimum period of 6 months, and thereafter terminable at one month's notice, stipulate that traffic stored shall have been conveyed, or shall be intended for conveyance, by rail.

Covered accommodation.

Warehouse space in buildings which are rail-connected, and are usually located in a goods yard, is offered for the storage of all kinds of traffic requiring suitable protection.

Short-term agreements are made as in the case of uncovered accommodation.

Building sites at Railway Depots.

Sites are leased to clients on a long-term basis. Erection of permanent buildings for storage is encouraged, and a clause is

usually inserted in the lease binding the traffic to rail. An endeavour is made to obtain the full market letting value of the site, but regard is paid to the traffic value of the tenant.

Space is rented in a number of the Pennsylvania Railroad larger freight stations to private industries for storage. It is also rented to shipping or forwarding Companies whose function it is to consolidate small consignments into full wagon loads to obtain the benefit of reduced rates for larger quantities. Industrial sites in the larger terminals adjacent to rail facilities, have been acquired for rental or long-term lease, with permanent buildings erected on such sites. The renting of such facilities is dependent upon the volume of traffic offered, which is related to the value of the site.

In New Zealand, no space in stations is rented to any clients, nor have industrial sites been acquired alongside stations for the specific purpose of letting.

The renting of railway premises for private use is not prevalent on Indian Railways, nor do they permit clients to erect permanent buildings on railway sites.

On the Egyptian State Railways, space is readily let to clients for storage in stations and alongside sidings. Clients are permitted to erect permanent buildings on such sites with long term leases.

Handling equipment.

Apart from warehouse cranes and chutes, which are provided as normal equipment, British Railways confine the provision of station equipment to the classical types of equipment, including cranes and gantries, but there has been a considerable development in the use of the mobile crane. Where special appliances, such as elevators, conveyors, etc., are required to deal with a client's traffic, these are provided at his expense either on a capital or rental basis.

On the Egyptian State Railways, ordinary cranes on goods platforms are provided for the use of clients when necessary, but special equipment is not installed.

Safe transit.

Safe transit by rail is impaired mainly by theft, breakage and wettage. None of this is peculiar to rail transport, but some of the circumstances of rail transport tend to aggravate their occurrence. A full account of the way in which the problem is being tackled on British Railways appears in the September-October 1949 *Bulletin of the International Union of Railways.* It may be summarised as follows :

Claims prevention.

Organisation.

The development of a comprehensive claims prevention system including the employment of special staff at station, district, and regional level; the use of statistics; and education of staff.

Packing.

The improvement of packing standards, and the application of agreed fibreboard packing regulations.

Handling and loading.

Standard methods of loading.

Use of bulkheads to divide loads.

Use of steel bracings (stillages).

Shelves in wagons.

Shunting.

Shock absorbing wagons for highly fragile freight.

Use of straw pads and rubber to cushion traffic.

Rolling stock.

Regular overhaul of tarpaulin covers used on open wagons and withdrawal of defective covers.

Improved type of covers.

Fitting of supporter bars to covers to avoid accumulation of water.

Periodical examination of covered wagons.

Labelling.

Consignments forming a full-wagon load for one consignee do not require to be fully labelled but traders are encouraged to label some of the packages in case wagon labels become defaced or lost.

Removal of old labels.

Freight highly vulnerable to theft.

Special precautions for such freight as:

Tobacco.

Wines and spirits.

Hosiery.

Clothing.

Textiles.

Staff co-operation.

Discussions with staff at all levels to develop interest in claims prevention.

Co-operation with trader.

Difficulties explained.

Advice given on prevention measures.

Illustrated pamphlets circulated through Chambers of Commerce and similar bodies.

Protection by statutory limitation of road competition.

In varying degrees, protection by statutory limitation of road competition has been found to be necessary in some countries. One form is limitation by licence by which numbers of vehicles and sphere of operation are controlled. In Great Britain some proof of need is necessary and competing suppliers of transport have rights of objection. The Transport Act, 1947, has narrowed the field of competition still further by requiring independent hauliers to obtain permits from the Road Haulage Executive to enable them to carry the generality of traffic more than 25 miles from their base.

Trader operated vehicles.

In Great Britain, competition from the independent haulier is substantially under control. The unresolved problem is that set by the trader operator who has complete freedom to flood the roads with his own vehicles. Trader operated vehicles have risen alarmingly in Great Britain, as shewn by the following table, and the situation is causing concern to the authorities. On the one hand, the value of a spur to the efficiency of nationalised transport is appreciated, but on the other, it is felt that the stability and progressive improvement of nationalised transport is being imperilled by not requiring the trader operator to prove the need for his operations. The Chairman of the British Transport Commission has said that « it may not be inappropriate to point out to traders and industrialists generally and particularly to any who may be thinking of resorting to private transport, that public transport can only pay its way if it is adequately patronised wherever it can give good service ».

Much can be done by way of efficient service and competitive rates to persuade traders to use the railway, but some way may have to be found to check the tendency for traders to employ their own vehicles on favourable traffic, and to look to the railway to carry the awkward and less remunerative traffic.

Year	Growth of Trader-operated vehicles		
	Vehicles 000's	Index on 100 for Septr. 1935	Monthly rate of increase
1935	304	100	
1936	317	104	+ 2 000
1937	362	119	+ 3 000
1938	365	120	+ 200
1946	384	126	+ 7 000
1947	487	160	– 9 000
1948	591	194	– 9 000
1949	675	222	8 000

In 1949 some 55 % of the trader-operated vehicles had an unladen weight of not more than 30 cwts. These vehicles were not so seriously competitive with the railway as the remaining 45 % consisting of larger vehicles. The proportion of heavy vehicles is tending to increase.

In South Africa the operation of private road operators is governed by the provisions of the Motor Carrier Transportation Act, under which the railway administration is able to oppose any application for road conveyance which may be in competition with established rail service.

The Government of India have formulated certain principles according to which

long distance goods traffic has been reserved for the railways, leaving the short distance traffic for movement by road, or rail, as clients may desire. Particulars are given in Appendix D.

All road transport in New Zealand must be licensed. Any interested party may object to the granting of a licence. Applications by the Railway to operate road services are opposed strenuously by the road haulage operators.

In Victoria, Australia, many types of operation are permitted, as of right, irrespective of whether rail services are available or not, and it is felt that the most effective way of conserving the higher grade traffic to rail would be the introducton of legislation requiring road hauliers to pay a charge for their use of public highways which would be commensurate with the cost of construction and maintenance of the roads. In Victoria, the relatively low licence and other fees are not commensurate with such costs.

Integration of transport facilities through State ownership or control of rail and road undertakings.

In view of the situation which has arisen in many countries through duplicated rail and road service leading to gross under-employment of the railway, the method of integration seems to offer more hope of a satisfactory solution to the problem than methods which cause still more competition and waste of assets. In short, the real answer to the whole of Question 8 falls into three parts, viz :

a) Improve railway facilities up to the level of cost which users are prepared to pay;

b) See that the capacity of the railway for efficient service is fully employed, so that those costs which do not vary with the volume of traffic, are properly spread;

c) Satisfy *b*) by using rail and road for those functions for which they are broadly the most efficient, aiming at complementary instead of competitive operations.

The possibilities of integration through State ownership and control of transport are beginning to be illustrated by the developments in Great Britain since the passing of the Transport Act, 1947, under which railway and long-distance road undertakings (in the main) come under national ownership and control. It is the general duty of the British Transport Commission, set up under the Act, so to exercise their powers as to « provide, or secure, or promote the provision of an efficient, adequate, economical and properly integrated system of public inland transport and port facilities for passengers and goods ».

The Chairman of the Commission has said « it is clearly desirable to influence traders as strongly as possible to use the means of transport which can be shewn to be most economical in terms of real social cost ».

Traffic « by full wagons loads », in the terms of the question, can surely be carried most economically by railway in a very large number of cases, particularly where full wagon loads can be converted into full train loads from point to point. This is particularly true of the longer distance hauls. One of the problems, therefore, in Great Britain, and possibly elsewhere, is to analyse costs so as to establish as nearly as possible what are the circumstances in which full wagon load traffic can be carried more economically by railway than by road, and then, in the case of Great Britain, to use the powers contained in the Transport Act, 1947, to steer such traffic on to the railway.

Cost analysis.

The difficulties surrounding cost analysis as between passenger and freight are well known, and in some countries, such as Great Britain, the incidence of highway cost as a factor in road haulage cost is a recurring source of contention. A large scale cost analysis is being undertaken in North East England, by way of sampling the problem.

The question which this report seeks to answer specifically excludes the reduction of rates as a means of keeping traffic — by

full wagon loads — in the hands of the railway.

Even so, it appears to the reporter to be advisable to point out that in Great Britain rates are, in some respects, the crux of the situation. The Chairman of the British Transport Commission has said « charges will be the principal means of guiding traffic to the means of transport that can most economically carry it from a national standpoint; charges policy is probably the key to effective integration ».

Where distances are relatively short, as in Great Britain, the level of rates, as between rail and road, is highly important. Up to 200 miles and more, large quantities of traffic are road hauled on main trunk routes in Great Britain, and so long as the service is available at rates, many of which are well below rail rates, no effort by the railways to improve service is likely by itself to pull the traffic back to rail.

The Transport Act, 1947, requires the production of a Charges Scheme, which is bound to have its effect on the road-rail situation, but any attempt to use the Scheme to divert traffic from road to rail has to reckon with the continued freedom of the trader to operate his own vehicles without limit.

Complementary transport.

In Great Britain, therefore, the problem is also being tackled on the general basis of trying to employ the rail and road branches of nationalised transport more as complementary transport agencies, and less as rivals in the same field. The problem must not be over-simplified, but in essence, it amounts to restoring to the railway its most economically dischargeable function, viz., carrying traffic in through train loads between main traffic centres, avoiding staging, and using the road for feeder and distributor service and for cross-country service where the railway cannot provide this efficiently.

As an instance of this sort of development, traffic between London and Manchester can be cited. Before nationalisation a well-established road haulage company carried traffic on trunk motors regularly overnight between these two cities in both directions. This traffic is now collected and delivered at either end by the road haulage undertaking, but trunk hauled by railway, with substantial gain to the net revenue of the British Transport Commission. Arrangements are being made to extend this practice.

There is great scope for development on these lines provided a way can be found of satisfying employees whose existing employment must inevitably be disturbed.

Following the same line of approach British Railways and British Road Services are tackling regular streams of seasonal traffic, such as perishable fruit and vegetables, where in the past traffic has been conveyed over long distances by parallel rail and road services.

The Transport Act, 1947, leaves the independent operator free to operate up to 25 miles from his base, and therefore able to carry up to 50 miles in certain circumstances.

The nationalised road undertaking is primarily concerned with traffic outside the normal range of the independent operator. Between this bottom range, and the top range, for which the railway is superior, there is a middle range where the cost of cartage and extra handling of traffic when railborne closely approximates to, or may even exceed the total cost of conveyance throughout by road. This middle range may offer opportunities for compensating the diversion to rail of long-distance traffic now roadborne. There will still be left large quantities of short and medium distance traffic which, for various reasons, must remain railborne, e.g. non-carted traffic, unbalanced traffic flows, large blocks of traffic requiring immediate absorption in the transport system, such as imports, and traffic requiring storage facilities.

In Great Britain it is felt, in some quarters, that a valuable means of steering traffic to rail or road may well be found in the promotion of a common commercial organisation for all the transport services

of the British Transport Commission, so that the merits of the different forms of service can be presented together to clients, and the movement of traffic influenced to the mutual benefit of client and Commission.

SUMMARY

Terminal cartage.

Experience over a long period has shewn the traffic retaining value of terminal cartage. So far, the provision of the service from the largest possible number of stations has been preferred to concentrated arrangements, but the situation may change, where, as in Great Britain, the integration of rail and road transport may lead to British Road Services becoming more and more employed in extensive feeder and distributor services which would absorb local cartage. In the process, some branch lines, or intermediate stations on main or branch lines, may cease to be required, or be kept open for mineral traffic only, and worked with a minimum of staff and motive power.

Containers.

These have proved to be very useful, particularly on British Railways, which have a stock of some 21 177 of them, of various types. Should the integration of transport take the form described above, the use of containers is likely to grow apace in order to reduce the cost of transferring traffic between road and rail vehicles.

Wagon-carrying trailers.

These have not found favour in any of the countries covered by this report.

Rail-road trailers.

These are useful in special circumstances, but the demountable non-wheeled container is better because it can be carried by rail and road on standard interchangeable equipment. It also avoids the waste of capital assets represented by wheels, tyres, springs, and brakes, which are idle during the rail journeys.

Other methods of liaison with the station.

Pipe lines, suction plants, conveyor belts, and overhead wire rope conveyors, are all used to a limited extent, with advantage.

Speed.

Express freight movement over long distances is the best competitive weapon in the hands of the railway. It is necessary constantly to review and improve the freight schedules.

Regularity of transport times

This is just as important as speed, and it is essential to maintain and improve the punctuality of the services.

Use of privately-owned wagons.

The general trend is away from the privately-owned wagon, but it is permitted, with advantage, for exceptional traffics.

Storage.

This is a very useful facility, either before or after transport. It not only relieves pressure on clients' own premises away from the railway, but it also enables breaking from bulk to be undertaken.

Safe transit.

Railway transport is particularly susceptible to certain forms of breakage, wettage, and loss. Modern methods of claims prevention can do much to increase safe transit.

Protection by statutory limitation of road competition.

Much has been done by means of licensing to control the independent operator working for hire or reward. Competition from trader-owned vehicles is an unsolved problem.

Integration of transport through State ownership or contract of rail and road undertakings.

Where, as in Great Britain, the State owns and controls the railways and long-distance road transport, there are opportunities for steering traffic to the means of transport most suitable and efficient for it, but this can only be done with due regard to the interests of the client.

Appendix A

Illustrations of typical vehicles employed on BRITISH RAILWAYS.

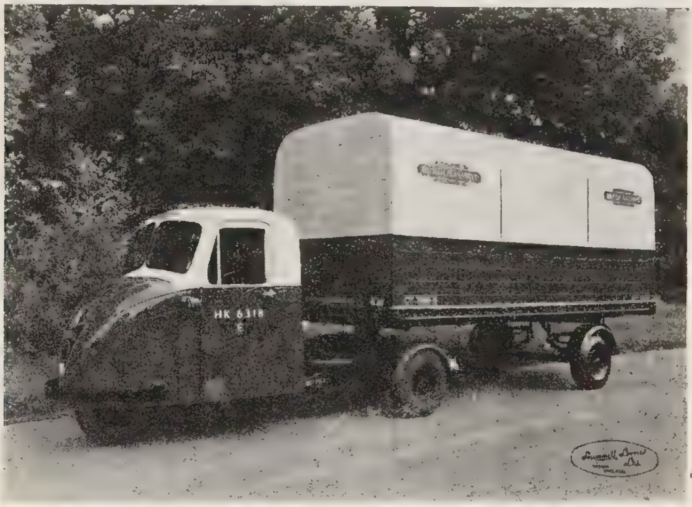


Fig. 1. — *British Railways.*
3-ton Mechanical Horse with covered trailer used for short distance cartage.

Fig. 2. — *British Railways.*
6-ton Mechanical Horse with low loading trailer used for short distance cartage of containers, etc.

Fig. 3. — *British Railways.*
6-ton articulated tractor with 6-ton flat trailer used for longer-distance cartage.

Fig. 4. — *British Railways.*
5-ton capacity lorry used for longer-distance cartage where articulated equipment would not be advantageous.

Appendix B

BRITISH RAILWAYS.

Descriptions and illustrations of container stock.

Fig. 5. — « **A** » **type covered small utility.**

	Length	Width	Height
	—	—	—
Interior measurements . . .	7 ft 4 ins (2.23 m)	6 ft 7 ins (2.01 m)	7 ft 3 ins (2.21 m)
Capacity	2 1/2 tons (2 550 kg)		
Tare weight.	1 ton 1 cwt (1 070 kg)		

Loading performed through end doors.

General utility container designed for the conveyance of a wide variety of traffics such as confectionery, groceries, boots and shoes, biscuits, wireless apparatus, textiles, etc.

Fig. 6.

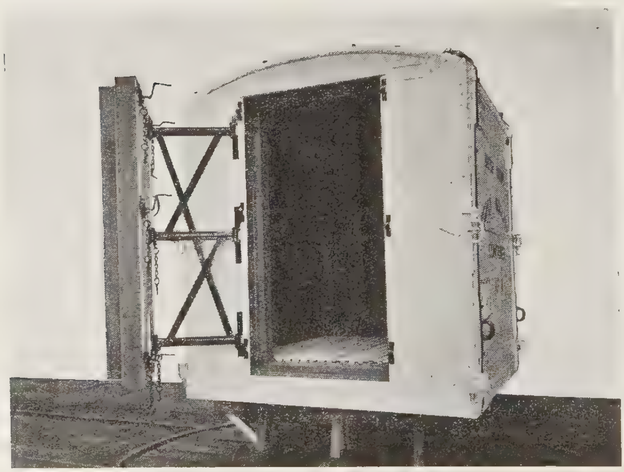
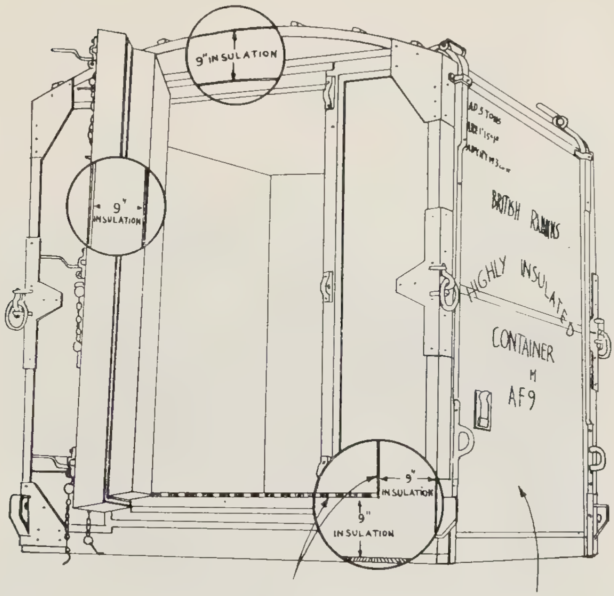


Fig. 7.



Inside lining.
3/16″ plywood with 28 S.W.C. galvanised steel face, all joints soldered.
Outside panels.
3/8″ plywood. Fig. 8.

Fig. 6, 7 and 8. — « **A. F.** » **type covered highly insulated.**

	Length	Width	Height
	—	—	—
Interior measurements . . .	5 ft 11 ins (1.80 m)	5 ft 5 ins (1.65 m)	6 ft 2 ins (1.84 m)
Capacity	3 tons (3 060 kg) 193 cubic feet (5.46 m^3)		
Tare weight.	1 ton 17 cwts 2 qrs. (1 910 kg)		

Designed specially for commodities which require to be conveyed at very low temperatures, e. g. ice-cream, quick frozen foods and frozen pancreas glands used in the manufacture of insulin.

Commodity temperatures as low as −15° F (−26° C) can be established over a 24 hour transit but the more normal range is between 5° F and 10° F (−15° C and −12° C).

Single door at one end only, specially slung on « floating » hinges and fitted with six lever action bolts. Rubber gasket at door faces to ensure perfect seal.

Insulated all sides, roof, door and floor 9 ins (23 cm) « Onazote ».

Timber construction with interior casing of metal faced ply (all joints soldered).

Technical data.

Heat : Transmission coefficient = 10 D. T. U. (2.5 kg cals). (In terms of B. T. U. per hour, per degree. Fah. difference between inside and outside temperature).

NOTE. — During a 24 hour test period when the difference between night and day temperature was 33° Fah. (18° C), with the additional adverse feature of strong sunshine during the day, the air temperature inside the (empty) container varied no more than 3° F. (2° C).

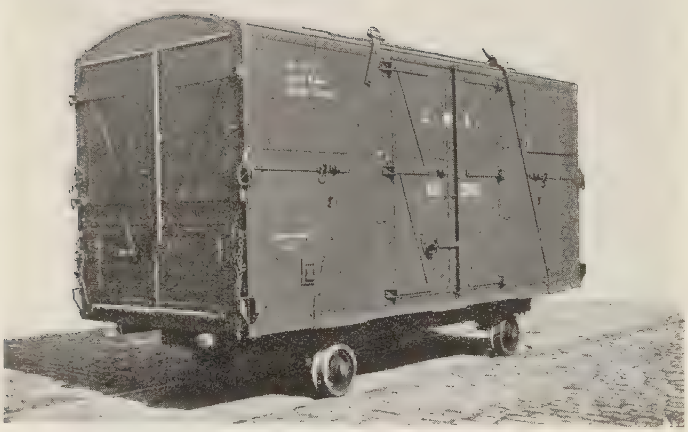


Fig. 9. — **« B. D. » type covered large utility.**

	Length	Width	Height
	—	—	—
Interior measurements . . .	15 ft 10 ins (4.82 m)	6 ft 7 ins (2.0 m)	7 ft 3 ins (2.21 m)
Capacity	4 tons (4 080 kg)		
Tare weight	1 ton 17 cwts. 2 qrs. (1 190 kg)		

Doors at one end and both sides.

General utility container designed for the conveyance of a wide variety of traffics, such as confectionery, groceries, boots and shoes, biscuits, wireless apparatus, etc.

Fig. 10. — **« B. K. » type covered furniture.**

	Length	Width	Height
	—	—	—
Interior measurements . . .	15 ft 7 ins (4.75 m)	6 ft 6 ins (1.98 m)	7 ft 3 ins (2.21 m)
Capacity	4 tons (4 080 kg)		
Tare weight	1 ton 9 cwt. (1 475 kg)		

Loading through end doors.

Fitted with interior slats to facilitate securing of furniture. Of particular use for the conveyance of household removals and new furniture.

In certain cases containers of this type are specially fitted internally, as an example, to carry cloth in one direction and garments on clothes hangers on the return journey.

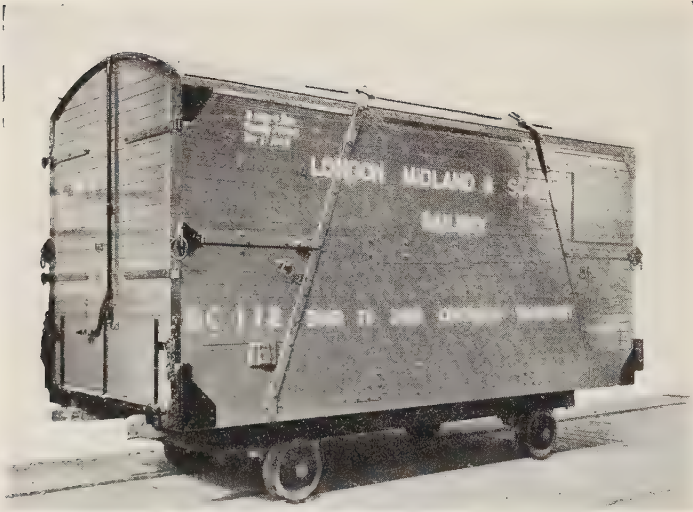


Fig. 11.

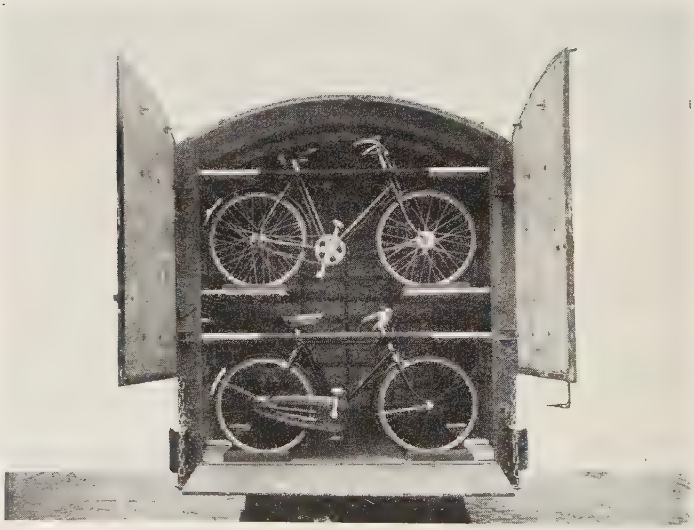


Fig. 12.

Fig. 11 and 12. — **« B. C. » type covered bicycle.**

	Length	Width	Height
	—	—	—
Interior measurements . . .	14 ft 2 ins (4.32 m)	6 ft 6 ins (1.98 m)	7 ft 10 ins (2.39 m)
Capacity	4 tons (4 080 kg) Approximately 70 bicycles.		
Tare weight	1 ton 11 cwt (1 580) kg		

For conveying bicycles. Fitted with racks to separate the machines in transit.

Fig. 13.

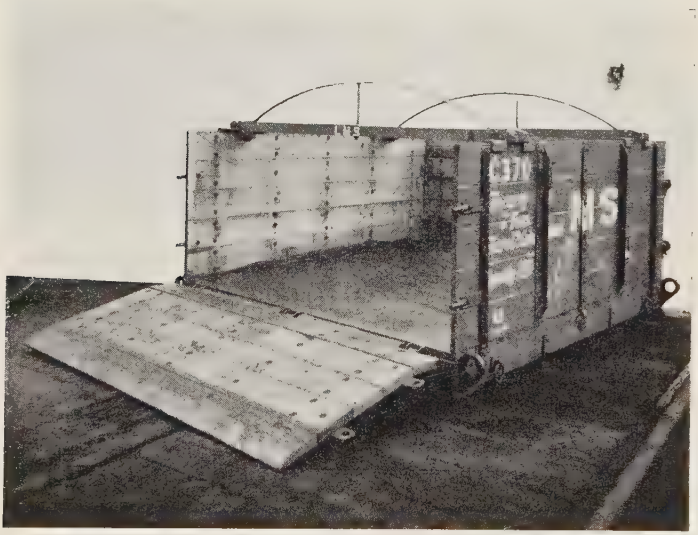


Fig. 14.

Fig. 13 and 14. — « **C** » **type.** — **Open medium.**

	Length	Width	Height
	—	—	—
Interior measurements . . .	7 ft 3 ins (2.21 m)	6 ft 0 ins (1.83 m)	2 ft 10 ins (0.86 m)
Capacity	3 tons (3 060 kg)		
Tare	12 cwts (612 kg)		

Doors fitted at each end for loading.
For the conveyance of glazed ware, stoneware, bricks, tiles, etc.

Fig. 15. — « **D** » **type open** — **large.**

	Length	Width	Height
	—	—	—
Interior measurements . . .	13 ft 9 ins	6 ft 0 ins	3 ft 7 ins.
	—	—	—
	(4.19 m)	(1.83 m)	(1.09 m)
Capacity	4 tons (4 080 kg)		
Tare	1 ton (1 020 kg)		

One end and two doors for loading.
For the conveyance of stoves, grates, heaters, machinery, baths, stone, bricks, tiles, etc.

Fig. 16. — « **H** » **type open — small.**

	Length	Width	Height
	—	—	—
Interior measurements . . .	6 ft 9 ins (2.05 m)	3 ft 9 ins (1.14 m)	1 ft 8 ins (0.51 m)
Capacity	2 1/4 tons (2 300 kg)		
Tare	3 c. 3 qrs. (191 kg)		

One end door for loading.

For the conveyance of bricks, tiles, firebricks, earthenware, decorative stone, etc. Is a convenient unit for craning to the upper floors of buildings in the course of construction.

Fig. 17.

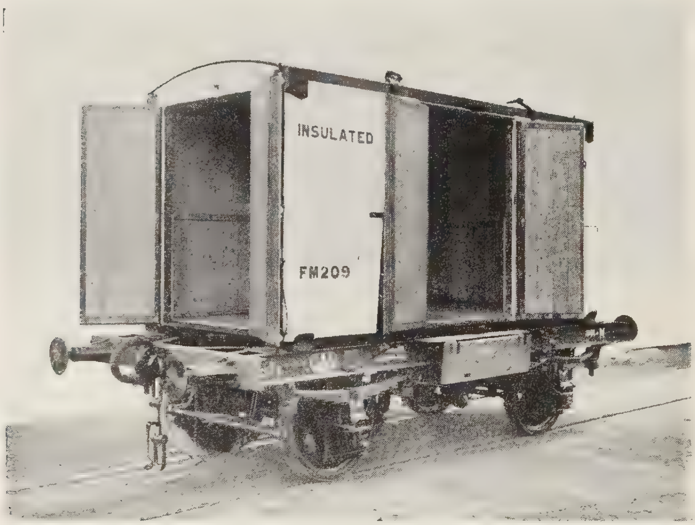


Fig. 18.

Fig. 17 and 18. — « **F. M.** » **type covered.** — **Insulated meat.**

	Length	Width	Height
	—	—	—
Interior measurements . . .	14 ft 0 ins (4.26 m)	6 ft 0 ins (1.83 m.).	6 ft 4 ins (1.93 m) to meat bars
Capacity	4 tons (4 080 kg)		
Tare	2 tons 1 cwt (2 090 kg)		

Insulated containers for conveyance of frozen meat, fish and other perishable commodities requiring the maintenance of low temperature.

Insulation material varies from 1 1/2 ins to 2 ins (3.8 to 5.1 cm) in thickness. Dry ice can be used as a refrigerant and some of the containers are fitted with roof bunkers for wet ice.

Bars carrying 48 meat hooks are generally provided for carrying carcases.

Fig.19. — « **B. M.** » **type covered.** — **Ventilated meat.**

	Length	Width	Height
	—	—	to meat bars
Interior measurements . . .	15 ft 7 ins (4.75 m)	6 ft 6 ins (1.98 m)	6 ft 10 ins (2.04 m)
Capacity	4 tons (4 080 kg)		
Tare	2 tons 3 cwts (2 190 kg)		

For the conveyance of fresh killed meat. Fitted with bars carrying approximately 70 hooks for hanging meat. Ventilated to ensure even temperature. End door and side doors both sides.

Appendix C

TYPICAL EXPRESS FREIGHT TRAINS.

Departure time	From	To	Arrival time	Remarks
8.20 p. m.	Park Royal (Return service for empties — 8.15 p. m.)	Newcastle	7.32 a. m.	Beer traffic. — Runs on certain days.
8.35 p. m.	London (Marylebone)	York	5.35 a. m.	General goods (ex. Saturdays).
11.30 p. m.	Lincoln	London (East goods)	6.32 a. m.	Vegetables and general goods.
10. 5 p. m.	Thames Wharf	Edinburgh	1.21 a. m.	Improved transits for motor cars and tractors to Scotland.
9.30 p. m.	Newport (Mon.)	Stourbridge Junction	3.30 a. m.	Steel traffic ex South Wales Works — to give a next morning arrival in Birmingham area.
6.45 p. m.	Bradford	London (St. Pancras)	1.55 a. m.	Woollen textiles ex West Riding.
8.10 p. m.	Moston	London (Camden)	4.10 a. m.	To give a one-day service from East Lancashire stations.
8. 5 p. m.	Edinburgh	London (King's Cross)	10.42 a. m.	General merchandise for London and South Eastern Counties.
6. 0 p. m.	Glasgow (College)	London (St. Pancras)	7.23 a. m.	Traffic for London and Southern Region.
9.10 p. m.	Inverness	Carlisle	11.10 a. m.	General merchandise to England.
2.10 a. m.	Hexthorpe	Mottram	5.16 a. m.	General goods.
12.15 a. m.	Ardsley (Leeds)	Whitemoor	6.38 a. m.	General goods for East Anglia.
11.30 p. m.	King's Cross	York	6. 0 a. m.	Now a fully fitted train for late goods.
8.50 p. m.	Whitemoor	Manchester	3.37 a. m.	Vegetable traffic.
8.40 p. m.	Whitemoor	Edinburgh (Niddrie)	8.12 a. m.	Vegetable traffic — Now a fully fitted train.
11. 0 p. m.	Cambridge	Acton	2.33 a. m.	General goods and vegetables for Western Region.
3.45 p. m.	Ebbw Vale	Acton	3. 8 a. m.	Steel traffic from South Wales to London Area.
4. 5 p. m.	Llandile Jct.	Old Oak Common	3. 5 p. m.	
8.45 p. m.	Olk Oak Common (London)	Penzance	10.40 a. m.	General traffic.
6.55 p. m.	Southampton	Nine Elms	10.42 a. m.	Import and general traffic.
11.14 p. m.	Feltham	Bournemouth	5.27 a. m.	General traffic.
9.20 p. m.	London (Somers Town)	Leeds	4.30 a. m.	General traffic.
10. 0 p. m.	Manchester (Ancoats)	London (St. Pancras)	3.57 a. m.	General traffic.
10.40 p. m.	London (Camden)	Manchester (London Road)	6.42 a. m.	General traffic. (Saturdays excepted).

Appendix D

Transport of goods by road in India.

The Government of India, with a view to defining the respective spheres of operation of services by rail and road, have evolved, in consultation with State Governments, a formula known as the « Code of Principles and Practice for the regulation of motor transport ». This provides inter alia for the restricting on an area or route mile basis the activities of road motor hauliers. The relevant provisions are reproduced below :

... ...

« (b) A public carrier's permit should normally be valid with due regard to geographical conditions, flow of traffic and marketing centres for a compact area — a circle with a radius of 50 miles.

A public carrier's permit valid outside the area described in (b) above should, wherever possible, be expressed as valid outside the « free zone », and the « compact area » if any, for a specified route or routes only. « Free Zones » may, if necessary, be added at other towns on the route or routes.

A regional authority should not, save in accordance with general or specific instructions of Provincial (now State) Transport Authority, grant, countersign or renew any carrier's permit valid for a distance exceeding 50 miles between places served by railways and should not in any case grant or renew such a permit valid for a distance exceeding 100 miles between places connected by railway, but should refer the application to the Provincial State Authority.

Save in accordance with any regular agreement between the railway or railways concerned and the Provincial (now State) Government a carrier's permit valid between places connected by rail should normally not be granted (or countersigned) or renewed —

(a) if the distance exceeds 100 miles — unless the Authority is satisfied that the goods for the carriage of which the permit is required cannot be transported by rail without undue expense or inconvenience at least in the outward direction and

(b) if the distance exceeds 300 miles — unless the circumstances are very exceptional or the goods to be carried in the outward direction are of highly perishable or fragile nature ».

« Between places connected by railway » means between places connected by a railway route not exceeding in length 1-½ times the length of the road where there is no break of gauge in the railway connection, and not exceeding the length of the road where there is break of gauge. Where a route originates or terminates at places off the railway, this distance and this criterion applies to the part of the route, if any, which is between places connected by railway, as defined and a place for this purpose means in relation to a town the municipal area and elsewhere any place within a distance of three miles from any railway station. »

It may be added that State Governments have not unanimously accepted all these distance limits, and negociations to this end continue. Nevertheless even at this stage Provincial Transport Authorities exercise considerable discretion in the grant, counter-signature and renewal of permits. Counter-signature is necessary on permits valid in more than one State.

[**656** .225 & **656** .261]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

15th. SESSION (ROME, 1950).

QUESTION VIII.

In view of the ever increasing weight of road competition, what are the most appropriate measures, apart from reduced rates, for keeping traffic by full wagon loads in the hands of the railway ?

Would not road transport at the end of the railway journey be justified in order to get direct contact with clients who are not connected up by railway sidings ?

Should not the road vehicles required to assure such transport be attached to centre stations, equipped with suitable handling equipment, from which the road transport services would start ?

Choice of the vehicles to be used.

REPORT

(Austria, Bulgaria, Czechoslovakia, Finland, Greece, Hungary, Italy, Portugal and Colonies, Rumania, Spain, Sweden, Turkey and Yugoslavia.),

by Mario DIAS TRIGO,

Chief Engineer of the Operation and Statistics Department of the General Management of Railways with the Ministry of Communications, Lisbon (PORTUGAL).

II. STUDY OF THE QUESTION.

A. General report.

B. Final conclusions.

III. SUMMARIES.

FOREWORD.

A detailed questionnaire relating to Question VII was to be drawn up in common, by the Reporters chosen to deal with this Question, during a meeting held in Paris towards the end of July 1949.

For various reasons only one of the Reporters was able to attend the meeting, M. GIRETTE, so that he had the honour of seeing his proposed questionnaire adopted by the Secretariat General of the Congress.

We wish to thank him for undertaking such a task, especially as, belonging to a country where the railway services are highly developed and in the forefront of the most up to date in the world, he included all the most important points to be covered in his questionnaire.

The replies received from the countries in Group II reached us too late, and most of them did not contain complete information on several points in the questionnaire.

This is hardly surprising as for some time Railway managements everywhere have been overwhelmed by requests for information, enquiries, and urgent questionnaires from international organisations, while on the other hand their own national life demands ever increased attention which is incompatible with the calm and well thought out enquiries of previous eras.

For these reasons, we wish to express our sincere appreciation and gratitude to the following Administrations and other Companies of Group II who replied to the questionnaire :

Bulgaria : State Rys.

Spain : RENFE (Red Nacional de los Ferrocarriles Españoles).

Finland : State Rys.

Greece : State Rys.
Piraeus-Athens-Pelopenesian Rys.

Hungary : Railway Department of the Ministry of Communications and Post Office.

Italy : State Rys.

Portugal & Colonies : Portuguese Rys.
Mozambique Colony Harbours, Railways & Transport.

Sweden : State Rys.
Swedish private Railways (Nora-Bergslag Ry).

Czechoslovakia : State Rys.

Turkey : Turkish State Rys & Harbours.

In order to facilitate on the one hand the task of the Special Reporter and on the other, comparison of the results of the enquiries in the countries in Group II and those of other countries, we have kept to the order of the questionnaire in our Report.

The first part of the report deals with the results of the enquiry.

The second part deals with the question as a whole based on the replies received and the Reporter's personal knowledge of the matter, which was greatly increased by the visits he made at the end of August 1949 to see the goods services and door to door transport organised in some of the Parisian stations at the invitation of M. GIRETTE, for which opportunity we also wish to thank the French Railways.

The third part of the Report is devoted to the Summaries which are the logical conclusion of the remainder of the report.

I. — RESULTS OF THE ENQUIRY.

Terminal transport of full loads.

On the Nora-Bergslag Ry. of the private Swedish Railways Union such transport is worked at most stations for certain goods such as timber and iron ore.

At the present time timber to the extent of about 10,000 tons per year, is always carried in full loads.

The percentage of such transport compared with the total traffic is about 80 %.

A very small part of the transport is worked by the Railway and its staff, the greater part being handed over to a haulage contractor by means of a contract covering a certain amount of timber over a fixed period.

Payment is made per cubic metre and the terminal transport is able to cover its own costs without having to be subsidised in any way.

Clients are not obliged to have consignements delivered door to door; they are entitled to require door to door delivery of a part of their trafic, though this right is not used at present.

The contractor loads and unloads the wagons himself, but if lorries belonging to the Railway are used, the lorry staff load and unload.

The main difficulties to be overcome to obtain satisfactory working of the whole organisation is to have a sufficient number of suitable wagons available for clients.

The Swedish private Railway Union considers that their clients are very satisfied with the present organisation, which has enabled them to recover timber traffic from the road hauliers.

The organisation of terminal transport of full loads from central stations does not apply here, as there are no such stations on any of the railways belonging to the Union.

In general on the Swedish State Rys terminal transport has only been organised in the case of parts loads, and only on certain lines.

Haulage services have been organised in 334 towns and other places of some importance.

These services are primarily intended to deal with small consignements, but they can also deal with full loads.

The haulage rates are published so that clients can obtain the necessary information about the haulage services offered and their charges.

In the case of full loads, however, the rates are only fixed in some cases.

In all other cases a preliminary agreement must be made between the consignee and the haulier.

According to the contract made between the Railway and the haulier, the latter does not act as the agent of the Railway in the case of full loads. On the contrary he is considered to be the representative with the Railway of the consignor or consignee.

The regulations in force since 1925 do not contain any clauses concerning the collection of goods from the consignor's premises.

The hauliers are generally private firms under contract with the Railway. In a few cases the haulage services are carried out by the Railway itself, and in other cases, which are becoming more and more frequent, by two road transport firms belonging to the State Railways.

These firms which are officially joint stock companies were originally set up by the private railways which were nationalised in 1945 and 1948.

Since then they have developed considerably and at the present time in the different depots they have about 580 vehicles of an average capacity of 4 tons.

In many cases the prices charged depend upon an agreement between the client and the haulier, and are generally based on the maximum prices fixed by the competent authorities. The Railway does not interfer in any way in the business affairs of the hauliers who do not receive any subsidy.

The Terminal Transport should cover its own costs.

In certain cases, in order to meet road competition, clients are given a fixed rate for the whole journey, from one end to the other, generally based on a cheap railway rate and including the terminal transport costs.

These reduced rates are always granted subject to certain conditions : The client

must send all such traffic by rail : there must be a certain minimum annual tonnage, etc.

Loading and unloading the lorries at the station and at client's premises is done by the haulier. In certain cases loaders are used for goods in powder form.

In Turkey there is no organisation to deal with the terminal transport of full loads.

In Spain the terminal transport of complete loads is very rare since such transport is usually carried out by the firms concerned themselves in their own vehicles.

If such transport is required, the existing organisation for the terminal transport of small consignments is made use of, or special agreements are made, which is the general practice in the case of certain goods (inflammable materials, explosives or dangerous goods), and for consignements exceeding a certain size or weighing more than 100 kg (220.46 lbs.).

The Railway staff is only responsible for the handling at the station, all other loading and unloading being carried out by the client or the haulage contractor.

The charges for collection and delivery are based on the weight and mileage, or are the subject of a preliminary agreement.

They have to cover their own costs, and are independent of the railway rates.

Door to door transport is never made obligatory for clients, but the latter are not entitled to demand such services for only a given proportion of their traffic.

On the Greek State Railways, such an organisation only exists at certain stations.

Bulk goods, fresh meat, fresh fish, and perishable goods as a whole are excluded from door to door transport service, as well as excessively large or weighy goods.

Goods must be packed just as in the case of small consignements, i.e. put in sacks, cartons, etc.

The percentage of terminal transports compared with the total traffic is still very small as can be seen from the following statistics covering the two main stations of Athens and the Piraeus.

STATION	Year	Terminal transports (in tonnes)	Total traffic	Percentage ratio
The Piraeus	1948	1 020	23 215	0.04
	1949 (Jan-May)	76	6 154	0.012
Athens	1948	869	40 872	0.02
	1949 (Jan-May)	449	13 974	0.03

There appears to be some likelihood of increasing the volume of terminal transports owing to their recent extension to other categories of goods previously excluded (liquid fuels).

Up to the present door to door transport has been carried out by hauliers under contract with the railway, the typical contract is used being given in the Appendix. Now however it is proposed to start services at certain stations using the Railway's own vehicles.

The rates applied in the case of door to door services depend upon the weight and mileage.

Door to door services are entirely optional.

The handling of full loads at the station is done by labourers who are not on the permanent Railway staff, and who are paid according to the weight.

In the stations, cranes are used for heavy parcels, while the others are dealt with by hand.

The client himself is responsible for loading and unloading at his premises.

The main difficulty encountered in organising such transport satisfactorily is the excessive charges made by the contractors, in order to prevent the extension of such services, so that clients would prefer to have their work carried out by road transport.

The fight between the railway and the road being very intense at the present time in Greece, the State Rys. consider that it is very difficult to decide whether the traffic is held owing to the door to door services or because of the reduced railway rates, but they are of the opinion that it is probably due to the latter.

However the Piraeus-Peloponesian Rys. are at present trying to reorganise the terminal transport of full loads by haulage services, which now only exist at Athens station, and on a very restricted scale at the Piraeus.

These services are to be extended to all the main stations on the system, when the traffic warrants it.

The question of the kind of goods to be transported by full wagon loads does not arise, seeing that the tonnage does not exceed the available capacity.

Two systems are used to carry out the transport : in Athens it is done by the Railway with its own staff and vehicles : at the Piraeus by a haulage contractor under contract with the Railway, and only in the case of certain goods (potatoes and fresh vegetables).

The transit times are the same as in the case of railway transport, i.e. : proportional to the distance. As regards the collection services, all goods are collected during the afternoon if the telephone message is received in the morning, and the next day if it is received during the afternoon.

The rates are calculated in such a way that they just cover the cost of the lorry services.

The client is absolutely free to choose whatever haulage contractor he prefers for all, or any part of his traffic.

Handling at the station is carried out by the staff and mechanical gear of the railway, but the client is responsible for loading and unloading at his premises.

Terminal road transport of full loads is not carried out on the Hungarian Rys. in view of the fact that all their important clients are linked up with the railway by private sidings, and those firms or companies not so linked up have sufficient road vehicles to carry out their own delivery and collection services.

Moreover, the general tendency is for the Railway to devote itself according to its operating conditions to the railway services and for the road firms to deal with road transport.

As regards the organisation of terminal transport from central stations, it is considered that the closing down of the less important stations, and in particular suppressing the traffic on the secondary lines coming within their zone, would be premature under present conditions, from the economic point of view.

Moreover the rapid transport of full loads at reasonable and economic prices from door to door is entirely assured on the Hungarian system.

It is agreed that future development is likely to lead to the closing down of the small lines, but that such action will only become of moment in the distant future.

The Finnish State Railways have organised terminal transport of full loads for quite a long time, though originally such transport was confined to parcels traffic.

Such services are worked at all the stations where Railway lorries are available (at present : 42 stations).

This organisation has been developped and extended by degrees, and the tonnage carried is already considerable. Although no statistics are available regarding the quantities and percentages of full loads carried in this way, it is known that the door to door services dealt with about 200,000 tons in 1948, the greater part being small consignments.

The transport is worked by the Railway with its own staff and vehicles, the rates being approved by the General Management, but the officials dealing with these transports are allowed to make agreements with clients whereby they obtain reduced rates.

The additional charges made for the terminal transport does not always cover the cost, but this service retains traffic on the railway.

At the present time it is proposed to extend the collection services.

It is intended to carry out timber transport, by collecting the timber by lorry from the mills and if needs be and arranging for its delivery to the consignee.

The above measures have enabled the Administrations to retain and even to regain traffic.

Terminal transport of full loads usually is a paying proposition, so that this makes up to some extent for the loss often made by the door to door parcels traffic.

Door to door services are optional, and may deal with only a part of the traffic in question, the client himself dealing with the remainder.

In Finland the railway staff do the loading and the unloading.

There is no special mechanical equipment.

To prevent a poor turn round of the lorries, the management of the motor services , in each place where there are lorry services, is concentrated at a single centre, where the programmes for the service, running and use of the lorries are prepared.

Among the chief difficulties in organising and developping the motor services may be mentioned prejudice against this new kind of railway service, both among the railway staff and its clients, as well as the paucity of the funds allocated for the development of these services.

The clients have been well satisfied, and the State Authorities have been well disposed so long as the ordinances and official regulations are observed. On the other hand the private hauliers are not very enthusiastic about this new railway venture, because they are the opinion that State Railways have an unfair advantage over them, and they have done their best to hinder it.

The organisation of terminal transport of full loads from central stations is now being tried in Finland, in the South-Eastern region, known as the « Vuoksi Valley » (river linking up the Saimas group of lakes with lake Ladoga) but we are not yet in possession of any details regarding these services.

In Portugal the existing lorry services attached to the Railway are very limited, and their use is very restricted.

The Portuguese Railways consider that this is due above all to the liberty enjoyed by the road haulage services.

Terminal transport is entirely in the hands of private haulage contractors under contract with the Railway, but no arrangements have been made to extend to full load traffic the door to door services (collection and delivery) which clients are obliged to make use of.

However it is firmly believed that the satisfactory organisation of terminal transport of full loads would be a great help in the fight against road competition.

In the chief stations of the Mozambique Railways, the existing road services belong to the Railway.

The latter assures the transport to or from these stations of a full wagon (35 to 40 tons), by providing the necessary number of lorries to carry out the transport immediately (5 to 6 lorries at a time).

If there is more than one wagon to be unloaded or loaded, the transport is effected as lorries become available. In the meantime the goods remain stored at the station.

Before these services were introduced, the Railway was losing a great deal of traffic.

The development of this organisation since it was first started is shown by the tonnage transported by road to and from the railway stations, viz :

1932	5 297	tons
1942	73 345	»
1943	79 957	»
1944	100 111	»
1945	101 158	»
1946	109 239	»
1947	138 907	»
1948	152 647	»

The percentages compared with the total traffic were as follows at the following stations :

Goba	25 %
Guijá	40 %
Xinavane	40 %
Namialo	25 %
Iapala	90 %
Vila de João Belo	85 %
Inharrime	20 %
Mocuba	45 %
Mutamba	50 %
Nampula	99 %
Mutuali	90 %
Meconta	50 %
Rio Monapo	20 %

The transport in question is carried out by the Railway with its own staff and vehicles.

The time taken to deliver to the premises of clients rarely exceeds 36 hours from arrival of the goods at the railway station.

Four graded transport tariffs have been drawn up, by grouping together the different types of goods.

Reductions, by applying the next rate down, are allowed on the transport of these goods if the lorry is filled.

Heavy lorries are generally used for these transports, but the useful load may not exceed 7 tons in view of the fact that the most of the roads are unmetalled.

However on the good roads, 5 ton trailers (one or two) are used.

Six wheeled diesel engined lorries are now preferred, although the lorries with internal combustion engines are still used, but all these are now being replaced by diesel engines.

For the door to door services tractors are used, pulling three or four 5 ton trailers.

Large tonnages are nearly always carried by lorry to the railway station, making up full loads of cotton, maize, timber and other goods.

The output is generally much lower in the case of terminal transport of goods, generally consisting of imported goods, such as machinery, building materials, food stuffs, paraffin, petrol, etc., effected by the railway.

The cost varies according to the route used.

The financial results of carrying out terminal transport are very good, since the receipts cover the operating costs and amortization of the vehicles used.

In 1948 with 152 lorries in service, having an average capacity of 5 tons, the receipts amounted to 25,949,134 escudos (£ 325,974) and the costs to 21,383,941 escudos (£ 268,533).

It is considered that door to door services should be optional, and only run if clients so require.

All the traffic is carried at consignor's or consignee's risk.

The Administration does not hold itself responsible for any loss incurred through

alteration or suspension of the haulage services.

A client is at liberty to ask for door to door services for a part only of his traffic, and work the remainder himself or through a private haulier.

Handling at the station and at client's premises for loading and unloading the lorries can be effected either by the railway staff or client's staff, according to the case.

Handling is done by the client's staff on his own premises.

No time is fixed for loading and unloading the lorries, but clients are always asked to do so as quickly as possible.

No charges are made for standing time.

The main difficulties to be overcome apart from road competition, if this organisation is to work satisfactorily, are the excessive time some clients keep the lorries at their premises, and the shortage of vehicles for dealing with traffic peaks.

However it can be said that in view of the results obtained, the public like the railway haulage services since they have led to a reduction in the cost of transport as compared with the charges formerly made by the public road transport firms, and because of the remarkable regularity of this transport.

A law has been enacted protecting the Railway where there is competition; it decrees that on all roads running parallel to the railway and at a distance less than 75 km (40.47 miles) away from the railway, only privately owned lorries of not more than 2 tons capacity, carrying their own goods, can run, although there is no strict control over the road hauliers as to capacity of vehicles or origin of goods carried.

Although these road services belong to the State they have to pay the customs duties on fuel and imported goods just like any private firm.

The public road transport firms do not like the railway haulage services. They are encouraged in their attitude by the manufacturing companies from which they buy their lorries on credit terms.

The Mozambique Railways have no central stations, though the stations at the ends of the railway, from which roads into the interior of the country start, work on the same lines, as well as the road stations set up where roads branch off.

Road services have been set up also in all the stations for all places where there is any traffic which could be received by the Railway, or where such traffic could be created.

If there is not a sufficient number of lorries at a given station to assure the service, others are brought in by rail from the central lorry depot or from another station where they are not required at that particular time.

When the job is finished they return to the depot or station again, by rail if this is some distance away.

This makes it possible to carry out the loading of goods at the ports with perfect regularity, according to a previously established transport programme.

If the goods arrive at the port before the arrival of the boats on which they are to be loaded, they are stored free of charge for a period of 21 days.

The traffic is constantly increasing as the Colony develops.

In view of the special operating condition, there is no limit to the radius of action of the terminal transport services.

At the present time such services are assured up to a distance of 533 km (298.4 miles) by road, whilst transport up to 300 km (162 miles) is frequent.

In the first case the lorries are garaged for the night and the men use the dormitories that have been provided.

On the Czechoslovakian State Rys. there is no terminal transport of full loads, nor is it proposed to introduce this facility.

The consignees themselves carry out terminal transport, using their own vehicles.

Only in a few stations, where there are haulage services, are parcels carried according to the published conditions, either to all consignees or only to those who have asked for this service stating that they will not collect their own goods.

At the present time the introduction of a system of terminal transport from certain central stations is under consideration. in order to obtain an economic rationalisation in collaboration with the road services, and not solely to protect the railway against road competition.

A so-called « fast regime » has already been introduced to a limited extent on certain parts of the system, for parcels traffic.

This consists essentially of the setting up of depots in the towns where the goods are grouped, such depots generally being at the post office, in order to be able to collect and deliver parcels very quickly by road; the responsibility of forwarding such consignments being only retained by the « radius of action stations » and done away with in the others.

In addition to this, parcels are also carried, in the same way for the Post Office Department.

The « radius of action stations » are generally located in the centre of the district where the parcels that have come in by rail are delivered to destination by road, care being taken to choose stations which generally have a large parcels traffic, with easy road communications and appropriate depots.

Terminal transport is carried out in the case of all the goods carried by the Railway, either without any limit or with certain preliminary reservations fixed beforehand in the case of special or bulky goods.

The radius of action is about 20 km (10.79 miles) around the selected station.

The tests which began on the 1st July 1949 were extended on the 1st October 1949 in three cases.

This system of transport is at present being studied and tested with a view to being introduced throughout the country.

The transport is worked by three national undertakings, viz. the Czechoslovakian Railways, the Czechoslovakian Road Services and the Czechoslovakian Post Office Department.

The goods are accepted at the town depot, at the haulier's premises, or along the route, with the usual waybill.

The transport of goods from one radius of action to another is effected in principle by the railway, whilst transport within the zone is carried out in principle by road.

An additional transport time of 12 hours has been added to the times for through traffic and international traffic, though this may be less if the goods have only to be transported within the zone itself.

Ordinary lorries, with or without trailers and tractors with trailers are used for the goods; the vehicles are fitted with tarpaulins.

It is not yet possible to give the financial results of the terminal transport services organised.

Goods are delivered door to door or to the town depot without the clients having any option in the matter, and they must hand their goods over to an organization linked up with the Railway.

In principle the Railway employees carry out handling at the station, the consignor co-operating as far as possible.

Consignments weighing more than 1,000 kg (2 204.62 lbs.) or consignments made up of different parcels weighing more than 100 kg (220.46 lbs.) are loaded by the consignor and unloaded by the consignee, it being understood that the Railway staff must help.

The client has to give 24 hours' notice in the case of any consignment weighing more than 1,000 kg (2 204.62 lbs.).

The services are worked according to

timetable, the timetables being checked by the stationmaster of the zone station.

The Italian State Rys. have no special organisation at the present time for carrying out the terminal transport of full loads. On the other hand they have an organization which deals with both parcels traffic and full loads.

This organisation does not cover every station, but only those where the importance of the traffic justifies an efficient economical organization.

In 1948 a total of 187,000 metric tons (177,163.2 long tons) of terminal transport was assured, a tonnage which is however only a small percentage of the railway traffic to the 377 stations where the above mentioned organisation is in operation, and a still smaller percentages compared with the total railway traffic.

It should be stressed that the tonnage mentioned above consists of small parcels and consignements.

At the present time it is not proposed to extend this organisation.

The terminal transport is carried out by local firms under contract with the Railway Administration.

These contracts bind the hauliers to carry out the terminal services at the rates fixed by the railway in the different places and provide for the payment of the firms according to transport effected.

Additional transit times are added to the ordinary times for collecting and delivering goods, 10 hours in the case of express goods and 20 hours in the case of slow goods.

The price per hundred kilogrammes carried is the same for both classes, but varies according to the seven groups of localities as follows :

RATES

STATIONS	Price per 100 kg. (1)		
	Compact goods	Bulky goods	Minimum
	Liras	Liras	Liras
Rome & Milan	200	350	160
Group I	180	300	140
II	130	220	120
III	110	170	100
IV	90	140	80
V	70	120	70
VI	60	100	60

The terminal transport entirely covers its own expenditure without any subsidy from the State Railways.

In general door to door services are optional. Clients are completely free to make use of the railway organisation, private hauliers or their own vehicles, for all or part of their traffic.

(1) For consignments weighing more than 3 000 kg the lowest current rate is applied, if this rate is less, than that given by the tariff.

At the present time delivery has been made obligatory as an experiment and only in the case of the parcels traffic, at some stations in Milan, Rome, Naples and Bari.

Door to door delivery of small parcels (express and railway) is also obligatory in all the stations where this service has been organized.

For loading and unloading, either at the station or client's premises, no special equipment is used, and clients are not expected to be responsible for these operations.

The organization of the terminal services now in operation in Italy has not given rise to any special difficulties.

There have been reactions, on the other hand amongst private hauliers and clients, where obligatory collection of goods has been introduced.

It is difficult to decide to what extent the organization of terminal services has affected the retention or recovery of traffic.

The Italian State Rys do not think it opportune at the present time to organize terminal transport of full loads apart from wagon-conveying trailers and containers.

There is no doubt that such an organization would assist the railway in fighting road competition but only if the rates are lower than those of the road haulage firms in order to make up the gap between the total railway-plus-road charges and the road charges for the same service.

There are no comments on the terminal transport of full loads from central stations as this system has not been tried in Italy, and it is not proposed to introduce it at the present time.

Door to door techniques.

1. Transport by containers .

The Swedish Rys. do not make use of containers nor do the Turkish Rys.

However, the Swedish State Rys. are now making small containers to be used entirely for parcels traffic.

The RENFE (Spain) consider that the use of containers for full loads is possible and should be developped, in view of the economy afforded thereby as no packing is required and the wagons can be used to full capacity by grouping various types of containers (small, large and special).

For goods such as wines, cooking oils, fruit juice, liquid chemicals, small parcels, books, glassware, crockery or china, cloth, etc., containers can be used with advantage.

A definite example of the use of containers to meet road competition is their use between Barcelona and Madrid to carry cloth and other manufactured articles.

The capacity of these containers does not exceed 4 cubic metres (141.259 cub. feet), with a maximum useful load of 4,000 kg (8 818.48 lbs.).

The extension of the use of privately owned containers is also considered desirable in order to bind the contractors more closely to the railway.

With this object in view, special reduced rates are granted.

However containers are still not used to any large extent in Spain, and it has not been found necessary to introduce any special installations, apart from cranes, to handle the containers at stations.

This handling is always done by the consignor or consignee, who must load or unload the container within 8 hours.

The transport of the containers between the station and client's premises is always left to the client.

Private firms running container services also run lorry services for their door to door collection and delivery.

Single containers are rarely loaded onto a wagon. The grouping of containers over the common journey is favoured by granting cheaper rates above a minimum weight of 3,500 kg (7 716.2 lbs.) per wagon).

The Piraeus-Athens-Peloponesian Ry,. the Greek State Rys and the Hungarian Rys consider that it is very desirable, and in most cases, quite possible to develop the use of containers for full loads, but although their use has been studied, they have not yet been introduced.

They are considered to be an effective means of meeting road competition according to the economic and traffic conditions of each country.

In Finland, the Railway does not own any containers.

The use of containers in Portugal is still in the experimental stage, although they have proved satisfactory for carrying full loads of cement for a large dam which is under construction.

The development of privately owned containers is considered desirable, and they are encouraged as much as possible by reduced rates.

To facilitate the grouping of containers belonging to the Portuguese Rys as well as to demonstrate the advantages of this method, they have handed over their containers to a transport firm, their chief haulier, who uses them in the door to door services.

In Mozambique containers are not in use.

The Czechoslovakian Rys consider it desirable to develop the use of privately owned containers only for certain categories of goods.

In view of present traffic conditions and the experience already obtained, the Italian State Rys. favour containers having a useful capacity of 1 m³ (35.3148 c. ft.). Consequently they are now investigating the possibility of giving up the large containers (Group I containers) and concentrating their efforts on reparing the small ones (Group II containers), which seem best to meet their client's requirements.

The number of containers which totalled 1,415 in 1939 was reduced to about 1,200 owing to the war, 900 being small containers.

At the present time there are more than 400 Group II containers in good condition and most of them are rented out to private firms for a minimum period of three months.

The goods most often carried in containers are glassware, porcelain and aluminimum ware.

However the quantities transported compared with the total full load tonnage is very small.

The use of refrigerated containers is now being studied to carry perishable foodstuffs from Sardinia to the mainland.

The results obtained have not been satisfactory so far because the freight charges and supplementary charges now in force make the new prices prohibitive.

At the 31st August 1949, the position as regards containers in Italy was as follows :

TYPES	Characteristics						No.
	Useful load		Average tare		Average tonnage		
	c. mtrs	cub. ft.	kgr.	lbs.	kgr.	lbs.	
A. 11	1	35.314	285	628.313	500	1 102.310	927
21 (open)	1.3	45.909	270	595.250	2 230	4 916.330	22
22	3.3	116.539	470	1 036.170	2 030	4 475.370	41
32	4.8	169.511	580	1 278.680	1 920	4 232.792	23
40	8.2	289.581	990	2 182.580	4 010	8 840.526	46
41 (open)	2.9	102.412	500	1 102.310	4 500	9 920.800	9
42	6.9	243.672	860	1 895.970	4 140	9 127.084	11
52 refrigerator	6	211.888	2 400	5 291.100	2 600	5 732.000	62
62	12	423.777	1 100	2 425.000	8 900	19 621.100	25

Tank containers for powders, grains and various liquids are not used in Italy.

At the present time the Italian State Rys are encouraging the construction of privately owned containers, in particular those of a special type for furniture.

The development of these containers is also encouraged by granting a reduction of 50 % on the usual rates.

Handling of the containers at the station as well as their transport between the station and client's premises are always left to the client to arrange as he thinks best, usually by lorry.

2. Wagon conveying trailers.

Such trailers are not used by any of the Group II Railways who replied to the questionnaire except for Czechoslovakia and Italy.

However the Swedish State Rys have recently borrowed a trailer from the Italian Rys., with which they are carrying out trials on various parts of their system.

The trials already made have aroused great interest amongst the railway's clients, and have been very successful.

At the present time the construction of a wagon-conveying trailer adapted to the requirements of the Railway is under consideration.

The Czechoslovakian Rys. use Culemeyer wagon conveying trailers, of the standard type, but only to a very limited extent.

The stock, both trailer and tractor, belongs to the Railway.

It is considered that this method is not likely to be developped owing to the high capital cost and heavy operating expenses, and also the difficulties caused by the road regulations (bridges, width of the roads, etc.).

The P.W. method of carrying wagons on trailers is used by the Italian State Rys. who now have 76 tractors and 157 trailers.

It is mainly used in the case of wagons loaded with fragile and delicate goods, or heavy and bulky goods, which require special precautions, and whenever it is desired to economise in or do away with packing materials, which are often expensive.

This is so for example, when carrying furniture, glassware, metal scrap, heavy machines, coal, wood, cereals and bulk commodities.

This method of transport is particularly useful in the case of goods carried in special wagons (liquids, fruit), or refrigerator trucks (meat, fish), as in the latter case it prevents any break in the cold storage chain.

The P.W. type of trailer used in Italy is manufactured according to a patented model of the « Servizio Materiale e Trazione » of the « Ferrovie dello Stato ».

The iron framework is carried on 16 wheels, fitted on 8 half-axles and having cushion-rubber tyres.

Two lengths of rail are fixed on the frame.

They are fitted with continuous brake equipment acting on 8 wheels and a hand brake acting on the other 4 wheels.

The drawbar for coupling up to the tractor can be used at either end.

The trailer has the following dimensions : 7.6 m (24 ft. 11.13 in.) long and 2.85 m (9ft. 4.2 in.) wide (maximum).

The tare is about 8 metric tons (7.8736 long tons).

The weight on each wheel never exceeds 2,500 kg (2.4605 tons) (5511.6 lbs), which is the maximum allowed by the road regulations.

They can stand a load of 32 metric tons (31.4946 long tons) but the total combined weight of the trailer and its load must not exceed 40 metric tons (39.3682 long tons).

The smallest radius of curve that the trailer can negociate is 7 m (22.966 ft.) radius (outside curve).

They can easily run through even right angled curves.

The railway wagon is loaded on the P.W. trailer at the station, by means of a tractor fitted with a wire winch and a moveable loading ramp which can be quickly attached to one of the ends of the trailer.

To load in this way takes 10 minutes at the most, and unloading is still quicker.

In some stations there are also movable ramps which can be run on the actual lines, so that the operation is less tiring and takes 5 minutes at the most.

When it is not in use, the ramp is lifted off the line by means of a small crane.

Two types of tractor are used : « Breda 32 » and « Breda 40 » fitted with a 50 HP engine, five speeds [I — from 1 to 2 km (0.621 to 1.2427 miles); II, from 2 to 5 km (1.2427 to 3.1096 mi.); III, from 5 to 9 km (3.1069 to 5.5923 mi); IV from 9 to 16 km (5.5923 to 9.9419 m.p.h.), and V from 16 to 30 km (9.9419 to 18.6412 mi. per hour], running on petrol (except for 9 using naphta).

They are able to climb gradients up to a maximum of 8 %.

The radius of action of this method of transport is about 2 km (1.2427 miles) from the station. In some large towns (Rome, Milan, Genoa, etc.), the average distance may be as much as 10 km (6.2137 miles).

In exceptional cases, runs of up to 100 km (62.137 miles) from the railway station have been made with these trailers, with considerable loads, without experiencing any trouble.

The width of the roads must be at least 3 m (9.843 feet).

In 1948, 25 278 wagons were carried in this way. In the first quarter of 1949, 13.367 wagons.

At Milan, Genoa, and Turin on the average 10 wagons are carried daily. In other places the average falls to 2 wagons a day.

There are often peak periods of traffic in the orange season (December to March), in the autumn period for wines and must, and in the summer season for fresh fruit. Peak periods always occur in the case of bulk goods (grain, coal) unloaded from ships and intended for the interior of the country.

In the stations where there is no special equipment except that indicated above, the work usually takes place on a single line, on the level, with a minimum length of 40 m (131.234 feet).

In the most important stations and in 50 % of the others, the service is operated by the Railway using its own tractors and trailers, and staff, (2 men per tractor).

Present stock : 76 tractors and 15 trailers belonging to the Italian State Rys.

The client pays a fixed sum per wagon of :

2 800 liras for transport up to 1 000 m (3 280.8 feet);

3 600 liras for transport up to 2 000 m (6 561.7 feet);

4 200 liras for transport up to 3 000 m (9 842.5 feet);

and a supplement of 600 liras for each additional 1 000 m (3 280 feet).

The rates apply in the case of wagons loaded with up 12 tons, a supplement of 150 liras being charged for each additional ton.

In other places the service is operated by private firms, either on their own behalf or on behalf of a third party, holding a concession from the State Rys and owning their own tractors and trailers.

Sometimes the Railway rents tractors and trailers to them.

The present private stock is about 20 tractors and 18 wagon conveying trailers.

It is considered desirable for clients to own their own tractors and P.W. trailers, to link them more closely with the Railway.

Difficulties arise in extending the system owing to the high cost of the tractors (new about 7 to 8 million liras) and trailers (about 4,250,000 liras).

The transport of wagons by these P.W. trailers is of interest since it avoids double handling of the goods on the one hand, and on the other the rates applying are the minimum ones, based on 100 kg per km.

The station installations are fairly simple and no charge is made for their use, unless the track has been specially equipped for a single firm, when a tax of 200 liras per wagon is charged, to recover some of the expenditure.

When the service is in the hands of a private firm, there is not the same need for special sheds for the tractors.

The road regulations do not give rise to any difficulties with regard to P.W. trailers.

Before organizing such services however a licence to run them must be obtained from the authorities concerned, which is generally granted with restrictions concerning the central portion of the town, or all narrow roads, or roads with weak foundations.

This is relatively unimportant, however, since nearly all the industrial and commercial firms have their premises on the perimeter or on easily accessible roads.

Some communes (Milan, Como, Florence) require a special tax to be paid on P.W. trailers, as it is necessary for them to be escorted by one of their road patrolmen.

In other communes, instead of a general licence, permits are issued for each run on which the route to be followed is indicated.

It is considered that this method of transport with P.W. trailers is a fitting and efficient method of increasing the railway traffic and of persuading clients to make use of the railway although the total rates may in some cases be a little higher than the cost of railway transport plus road transport.

The fact that the goods can be loaded and unloaded in the factory or store itself is doubtless convenient and practical. Moreover, the inevitable losses with certain goods (such as coal and oranges) during transhipment at the station or during the road journey are avoided.

The advantages make up for the cost of using P.W. trailers, even when these are rather higher than the cost of transporting the goods by lorry.

The Italian State Rys are of the opinion that it would be desirable to extend these services so as to be able to achieve double transport by the trailers both at the departure and arrival stations.

On the 1st January 1943 such services were organised at only 19 stations. After the war the service was resumed and extended as follows :

15 stations at the 1st January	1947
21 stations at the 1st January	1948
33 stations at the 1st January	1949
43 stations at the 1st September	1949

It was expected that at the end of 1949, 70 stations would be equipped for these services, which were resumed gradually for financial reasons.

At the present time 76 tractors and 157 trailers are availabe, all belonging to the Administration.

Although it is not proposed to increase these numbers, everything possible will be done to obtain better user thereof.

3. Rail-road trailers.

Rail-road trailers are not yet used by any of the Railways in Group II who replied to the questionnaire.

In Sweden and Finland the only trailers used are road trailers which can be hauled over the roads by a tractor at the same speed as a lorry, but which are not loaded onto wagons.

4. Other ways of linking up with the station

In Sweden, Portugal and Mozambique no special installations are used to unload

goods at the station and convey them automatically to the consignee's premises, or vice versa.

In Spain there are a few special installations to facilitate the drawing off of wines, alcohols, and also, to a lesser extent, hydrocarbons.

Underground pipe lines are used in particular between clients premises and the unloading lines.

Barcelona-Morrot Station has a special dock with conveyor belts to unload sacks of grain which are stored in an upper storey.

Barcelona-Terminus Station also is equipped with conveyor belts to carry parcels and luggage.

The different overhead lines in existence all belong to private firms and are principally intended to carry ore and stone from mines and quarries to the loading points in the stations.

Special lines in the station for such traffic usually come under the same tariff system as private sidings and rented sites.

The client always loads and unloads the goods with his own equipment and his own staff.

To facilitate loading and unloading, full wagons sites alongside the sidings are often rented or allocated to clients, when this can be done without interfering with the station services.

The renting conditions are regulated by contract.

In Greece, Salonica station, there is one single example of other methods of linking up with the station : a pipe line installation with hydraulic crane to fill tank wagons with fuel oil.

In Hungary there are also a few stations equipped with pneumatic conveyers for grains, and overhead lines for bulk goods, especially coal and rubble.

These installations belong to private firms, in particular mining or milling companies.

Measures concerning transport conditions.

5. The part played by speed.

For the transport of parcels at speed between the main stations, the Swedish private Railways use their own lorries, but only in the case of small consignments, if this will speed up the transport.

Certain categories of goods (for example : cattle, early vegetables, etc.) are always sent express.

To speed up the transport of full loads such wagons are uncoupled from the trains without extra charge.

On the Swedish State Rys. the two classical speed divisions are still retained, express and slow. It is the consignor who always decides which way the goods are to go.

One important group of goods, perishable goods, is sent express at the slow goods rates plus a surtax of 10 to 20 %.

This group, which covers fish, vegetables and fruit has been extended to include meat and pork butcher's meat and, as an experiment, fresh bread as well.

Since the transport of perishable goods suffers seriously from road competition, express trains have been introduced over long distances, which make the journey times very favourable.

Several express and slow goods trains included in the timetable in recent years have been successfully used to fight road competition.

In Sweden, slow goods trains generally have a maximum speed of 60 km/h (37 m.p.h.).

In certain cases the speed has been increased to 70 km/h (43 m.p.h.) to enable the trains to arrive at the desired time.

To speed up arrival at destination of certain wagons in cases where there is much competition, these are so positioned in the train that they will leave the marshalling yard for their destination as quickly as possible.

Express trains and passenger trains are used to a certain exten for slow goods traffic, when in view of competition ordinary trains will not do.

To give some idea of the way the slow goods services have been speeded up, the Swedish State Rys have supplied the following figures showing the present transit times over certain runs compared with 1930 :

RUN	Km	m. p. h.	1930	1949	Improvement
Stockholm-Göteborg . .	456	283.3	12 h 43 m	9 h 55 m	2 h 48 m
Stockholm-Malmö . . .	599	372.2	23 h 20 m	15 h 24 m	7 h 56 m
Stockholm-Östersund . .	547	339.9	33 h 28 m	15 h 5 m	18 h 23 m
Stockholm-Lulea	1 130	702.2	55 h 25 m	29 h 32 m	25 h 53 m
Göteborg-Vasteras . . .	453	281.5	19 h 40 m	14 h 41 m	4 h 59 m
Göteborg-Malmö . . .	299	185.8	12 h 03 m	7 h 23 m	4 h 40 m
Malmö-Lulea	1 630	1 012.8	81 h 50 m	44 h 33 m	37 h 17 m

On the Spanish Rys. in the last few months experiments have been made when transporting full loads by the slow goods regime with the method of grouped consignments used on the other European Railways, which makes it possible to achieve a rapid and economic routing.

Only fish, fresh meat, milk and other categories of goods of the same kind are sent express; special rates for the transport of these goods over more than 25 km (15.5 m.p.h.) result in lower charges than the general rates.

Cattle are accepted as slow goods, but are sent as fast as possible by goods train.

In Spain road competition is very keen in the case of fish. To retain this traffic on the railway, it is sent by through trains from the ports, especially in the North-West and South, to the consuming centres.

These through trains also run between the industrial region of Catalonia and the most important consuming centres in the interior of the country, to carry parcels and manufactured goods express, as such traffic is easily lost to the road.

In the last few month a great many special trains have been run for the transport of large masses of goods by slow goods, particularly raw materials and food stuffs which generally cannot afford to pay the road haulage rates, though in certain circumstances, they can be carried by road. The railway services still have the advantage here.

As the road services have started to experiment with the carrying of cattle, special trains have been organised for such long distance transport, allowing the firms who specialise in such activities special facilities as regards the way they are marshalled etc.

In Greece, there are three speeds, viz slow goods, express goods, and extra fast express goods.

Cattle, early vegetables, fresh meat, fish, etc. are sent express goods though they pay the slow goods rates.

If the distance is under 300 to 350 km (186.4 to 217.5 miles) all arrangements are made to complete the journey in one day.

The Hungarian Rys. have not made any modifications in recent years to the classical division into slow and express goods, at the choice of the consignor, but the express goods service has been extended systematically, without increasing the rates, to certain categories of goods for which it is a physical necessity, for example : cattle, early vegetables, and perishable goods in general.

In addition goods sent by full loads are carried as quickly as possible, even if this adds to the cost.

On the Finnish State Rys. the express goods regime is applied, without increasing the rates, to certain perishable goods. Foodstuffs are generally charged at the highest slow goods rates, with the exception of milk, whey and drinking water, which come under more favorable rates.

As for speeding up full loads, attempts have been made to increase the number of through trains and reduce the marshalling involved.

In Portugal the classical division into express and slow goods has been retained, although road competition has also made it necessary to speed up certain traffic, such as cattle.

In the same way on the Mozambique Railways the present organisation is based on express and slow goods, at the consignor's option.

All goods which easily deteriorate, such as vegetables and other fresh produce, early vegetables, fish, meat, bread, ice, etc. are sent express at a slightly higher rate than the slow goods rate.

For certain goods, when the tonnage is high, through trains are run, at approximately the same speed as the passenger trains, especially in the case of the international services.

For example complete trains of petrol, fuel oils and lubricants are run.

Local services are assured by means of stopping trains.

So as not to delay the transport of goods and taking into account the effects of road competition, a minimum of three quarters of the capacity of a wagon is taken as being a full load.

Door to door delivery has not been improved since the war owing to the shortage of rolling stock and tractors.

On the Czechoslovakian Rys. no essential modifications have been made to the organisation of the traffic into express and slow goods.

When perishable goods are sent in small consignments, the rates are the same in both cases.

In the same way on the Italian State Rys. no modifications have been made in the extra fast, express and slow goods services.

The ordinary express goods services only apply in the case of full loads.

Small consignments can only be sent by extra fast or express goods.

The percentage of 25 % for the increased speed is not charged at Parma.

Early vegetables may be sent at the various tariff rates, and are put on the special foodstuff trains (fast trains).

6. *Regular transit times.*

In Sweden (Union of private railways) the theoretical transit times have not been reduced, but the actual times have been considerably shortened in practice.

The Railway advise clients of the arrival of wagons. In the case of important traffic, the main stations advise the destination station. It is considered that this preliminary advice is of advantage to the consignee.

On the Swedish State Rys the time taken for delivery was reduced in 1940. It is shorter than in the case of the international traffic, but is still relatively long when the actual transit time is taken into account.

In the case of express traffic 24 hours are allowed for sending off the goods and a transit time of 24 hours for each 400 km (248.54 miles). If the journey is less than 100 km (62.137 miles) the transit time is only 12 hours.

The system of guaranteed transit times is not in orporation at the present time, nor is it under consideration.

Empty wagons are advised as well as loaded wagons in the case of slow goods trains, with the object of speeding up the turn round, although not essential to fight road competition.

In Spain the theoretical transit times have not been reduced on account of competition.

In the case of express traffic, these times are as follows :

Consigning	— 12 hours.
Transport	— 12 hours per 100 km (62.137 miles) and one hour for each 20 km (12.4274 miles) over and above.
Transmission	— 6 or 12 hours according to whether there is a common station or not.
Delivery	— 2 working hours.

Owing to present conditions, these times have been doubled, with the exception of such traffic as fish, cattle, fresh meat, fresh fruit, vegetables, etc. These are always carried as quickly as possible.

Clients are notified of the arrival of wagons by notices posted up in the stations or town depots.

Such notification is considered an advantage, but does not have a decisive effect as regards competition.

In Greece the theoretical transit times have not been reduced. In the case of express goods the times are 24 hours per 125 km (77.67 miles).

No faster guaranteed transit times are in force, though every attempt is made to carry the traffic as quickly as possible.

Clients are not given a preliminary notification of the arrival of wagons, and it is thought that under present conditions in Greece such notification would not be a decisive advantage for the Railways against road competition.

In Hungary the theoretical transit times have not been reduced on account of competition. These times are those laid down in paragraph 1 of clause 11 of the C. I. M.

In practice everything possible is done to shorten the transit times as much as possible.

However there is no system of guaranteed shorter transit times on the Hungarian Railways.

As regards giving a preliminary notification of the arrival of wagons, this is done by telephone to the destination station.

This has not been introduced in order to fight road competition, but principally to obtain a quicker turn round of the stock.

The transit times have not been reduced on the Finnish State Rys. As regards preliminary notification of the arrival of wagons, the only fact to be reported is the control of transport and the sending of wagons to the export ports, in order to adapt the arrival of wagons to the requirements of the maritime traffic to the greatest possible extent.

The transit times in force on the Czechoslovakian State Rys are those laid down in the C. I. M.

Stations must give the consignee a preliminary notification of the arrival of wagons, but it is considered that this does not influence his choice when there is road competition.

In Italy the transit times were doubled during the war, reduced by 25 % immediately afterwards, and have recently been brought back to their pre-war level.

In the case of ordinary express goods, the following times are in force :

12 hours for operations on departure;

24 hours for each continued distance of 250 km (155.343 miles) of the journey up to 500 km (310.686 miles), then 18 hours for each additional 250 km.

Additional time is required for transport arriving or leaving certain stations, or in special cases.

For transport carried by non-stop or fast passenger trains, on payment of the prescribed supplements, the transit times are based on the train times.

For the time being it is not proposed to make any changes in this field.

No arrangements have been made to give clients advance notice of the arrival of wagons, but it is considered that such an organization might be of great value.

7. *The use of special privately owned wagons.*

In Sweden the Nora-Bergslag Ry. has bought 6 tank wagons for transporting fuel oils from the port on Lake Vänern.

The stock of special privately owned wagons is very small, viz :

2 wagons for transporting boats;

7 tank wagons for acids;

2 tank wagons for fuel oils.

The Swedish State Rys. attach great importance to the use of special wagons to fight road competition.

Their stock of special wagons in addition to refrigerator and cold storage wagons — in winter heated wagons — includes a large number of tank wagons. Most of the latter are privately owned.

Open wagon chassis are also provided for clients who wish to mount their own tanks on them.

This method has already been used in the case of the milk traffic.

A certain number of ordinary covered wagons have been adapted for carrying corn, with automatic discharge through the bottom. Other wagons have been adapted for carrying cement in bulk.

The RENFE (Spain) considers that it is very desirable for private firms to have their own special wagons not only to procure savings in packing and handling — which will attract them to the railway — but because they will obviously use them whenever possible in preference to the road services.

The actual stock of special wagons belonging to private firms is as follows :

316 refrigerator and insulated wagons, for carrying fish, fruit, fresh vegetables, flowers, and perishable goods in general;

1 658 tank wagons, for carrying petrol, oil and fuels, and other similar products;

2 550 tank wagons used to carry wines, alcohol and other similar liquids.

To encourage the development of special wagons, bonuses are granted on the transport carried, and reduced rates for journeys made empty.

The RENFE does not operate any special wagons of any kind itself; those belonging to it are operated by an affiliated company.

This method of operation has the advantage of resulting in better economic results in view of the specialization already obtained by the existing organization of road firms.

In Greece, where there are no special wagons, it is considered that such a system would be very desirable, though it is not possible at the present time.

In the same way the Hungarian Rys. consider that privately owned special wagons play an important part in the fight against road competition.

The Finnish State Rys own 57 tank wagons and private firms 396. Other special types of wagons are very rare on this railway, with the exception of refrigerated and heated wagons, of which the Administration owns a few hundred.

In Portugal the development of the use of special wagons is watched with great interest, a large proportion of those belonging to the Railway having been put at the disposal of the public, especially tank wagons and refrigerated wagons.

The Mozambique Railways have no special types of wagons.

The Czechoslovakian Rys. in principle are not against the registration of special wagons belonging to private firms, and they also own some which are usually rented out.

The stock of special wagons in Italy is as follows : for wine : 3,260; for petrol

and other such products : 2,434; for acids : 118; for vegetable oils : 315; for alcohol and molasses : 198; for other goods : 1,205.

The Railway also owns refrigerator and insulated wagons.

Empty journeys are not charged for.

No other measures as regards transport conditions have been applied by the Railways belonging to the Group II countries who replied to the questionnaire.

Station facilities.

8. Sites rented in stations alongside station sidings.

The Nora-Bergslag Railway in Sweden rents out sites in Lake Vänern Port on a large scale.

It has also acquired industrial sites alongside the stations which it is developing for renting to railway clients.

Long term leases are granted. The rent depends upon the traffic.

The Swedish State Rys. also rent sites in stations as available, but have not bought any industrial sites or other land to rent out to railway clients.

The length of the lease varies according to case; it is limited according to their future plans for the site in question.

The rents correspond to the value of the site. However in the case of an important client, the value of his traffic is taken into account in calculating the rent.

In the same way, on the RENFE (Spain) sites are rented alongside the lines to make it easier to load and unload wagons and store goods to be sent or received by rail.

With the same object platforms and sheds are also rented to clients, and sometimes goods to be carried by rail are stored free of charge.

Everything possible is done to provide private sidings which bind clients to the Railway.

Clients profit by reduced rates in this case owing to the fact that the Railway avoids a certain number of the terminal operations.

The sums fixed in such cases for renting sites, handling, etc. are always very low, in view of their object : to develop railway transport.

On the Greek State Rys. clients are able to hire sites in the stations and alongside service sidings, but this is rarely done.

The Company has not purchased any industrial sites so as to be able to rent out more sites.

The construction of permanent buildings on such sites is encouraged especially in the case of agricultural products.

The lease is for a period of 40 years, often at a nominal rent, but under the condition that any buildings erected will become the property of the railway on the expiration of the lease.

The Piraeus-Athens-Peloponesian Ry. also rents sites or even gives permission for depots to be set up without any charge. However this is only done on a small scale.

In Hungary, sites and depots can be let to clients alongside service sidings.

This is done on a large scale, but no land adjoining the stations has been purchased with this object in view.

Permanent buildings on such sites are encouraged, and in this case, long term leases are concluded.

The rents generally do not depend upon the traffic, but when there is no traffic or insufficient traffic the leases are terminated.

On the Finnish State Rys. the renting of sites in the stations and also alongside the lines is practised on a large scale, and the tenants can, on demand, be authorised to erect permanent buildings, such as stores, underground tanks, loading and unloading equipment, narrow gauge lines, etc.

Long term leases are possible.

The rents depend upon the amount of traffic at the station and the demand for sites.

At the present time in Finland the stations and yards are divided into 5 groups, for which different rents per m^2 are fixed, although reductions can be granted for certain reasons, for example if there are ponds on the site, if it is some distance away from the line, etc.

Recently the possibility of purchasing additional land in order to let out sites near the stations has been under consideration.

In Portugal the renting of sites in the stations to railway clients is encouraged as much as possible, the rentals being fixed on a definite scale which makes provision for an additional 50 % or 100 % when the sites are roofed in or have buildings on them.

The Mozambique Railways are now considering letting sites in the stations although there has been no demand for this from the public, in view of the fact that nothing is said when goods are deposited upon railway property so long as this does not hinder the running of the station in any way.

The only exceptions concern sites in the ports at the ends of the lines where sites are rented for storing minerals and coal on payment of a monthly tax based on the value of these products, not on that of the site.

Up to the present it has not been necessary to purchase land adjoining stations to increase the number of sites available for renting to the railway's clients, in view of the fact that they can obtain concessions of land beside the stations very easily from the Government.

The sites are sometimes served by one or more rail sidings.

In Czechoslovakia, sites, ramps and depots are rented to hauliers if the operating conditions at the station make it possible.

There are both short and long term leases.

Clients are allowed to erect permanent buildings on these sites so long as these are not used as workshops and provided that they encourage the transport of consignments by rail.

The Italian State Railways are extending in an ever increasing degree the practice of renting sites in the stations for loading and unloading goods.

Permanent buildings are only allowed on such sites in exceptional cases.

The contracts are generally made for two or three years and can be renewed every year, but the Administration reserves the right to resume possession at any time. The rents are in strict relation to the actual value of neighbouring land and the volume of the traffic guaranteed by the tenant.

9. Loading and unloading equipment available for public use.

As regards loading and unloading equipment available for use by the public, apart from cranes and gantrys in certain stations, no other equipment is provided in Sweden seeing that the Railway does not usually load or unload full wagon loads.

The equipment required for these operations belongs to- and is maintained by clients.

On the Nora-Bergslag Ry. (Sweden) special equipment is provided at the port platforms on Lake Vänern.

The charge for using this equipment is so much per ton of goods loaded.

In the same way the RENFE (Spain) only uses cranes and gantries, operated either by hand or electrically.

Special equipment is provided at the ports, mining districts, near factories, etc., but this all belongs to the users.

In Greece, Portugal, Czechoslovakia and Italy, the classical equipment, cranes and granties, is provided.

The Mozambique Rys. have provided special equipment at the ports at the ends of the lines, such as motor-cranes, excavators, to deal with the minerals and load them onto the wagons, caterpillar type bulldozers, Clark type elevators, tractors with several trailers, etc.

Only cranes and gantries are provided at the stations.

10. Other measures.

In certain stations of the Finnish State Rys. branch lines have been built on sites rented to railway clients, and clients can also be authorised to build such lines on their own land.

The Bulgarian State Rys. state that there is no road competition against them, as all transport is organised and each transport system deals with the traffic allocated to it according to the transport programme.

This result has been obtained by the creation of the Ministry of Transport which covers all methods of transport in order to be able to make a general plan in this way.

The fact that the different methods of transport are all under a single Ministry makes it possible to co-ordinate them by determining the duties and goods to be carried in each case, as well as their radius of action,

II. — STUDY OF THE QUESTION.

A. General report.

In Chapter I, we dealt with the situation as regards the terminal transport of full loads, door to door technique, measures concerning transport conditions and the facilities granted at stations in the countries in Group II covered by the present report.

These questions were dealt with in the same order as the Questionnaire sent to the Administrations, to make it easier to compare the above situations in these countries.

Except in Finland where terminal road transport of full loads has been in operation for twenty years, and in Sweden where it is organized in the case of certain goods such as timber and iron ore, no special organization has been created for this purpose on any other railways in Group II.

When transport of this kind is needed, the general practice is to make use of the existing organization for the terminal transport of small consignments, and in view of the fact that the terminal transport of full loads is rarely asked for, in the countries belonging to Group II, the extension of this system to such isolated cases can usually be done without difficulty.

At the present time in Greece attempts are being made to reconstitute the terminal transport services for full loads which, at present are only organized at two stations.

In Africa, on the Mozambique Rys,. in view of the special operating conditions, the development of the organization set up is truly remarkable.

It is unnecessary to stress the advantages of the terminal transport of full loads in order to reach clients who are not connected to the railway by private sidings.

It should be the aim to assure such transport by an appropriate organization wherever possible.

It appears however that this organization cannot be properly developped without the setting up road haulage services, either by the Railway itself, or by contract with private firms, or by companies affiliated to the Railway.

It is obvious that a universal solution is impossible in view of the special aspects of the problem in each country. Investigations into the development of the door to door services may lead to extended use of containers, and rail-road trailers or wagon-conveying trailers for the terminal transport of full loads, rather than the use of lorries.

Again in the case of containers, this is undoubtedly one of the most generally adopted methods of getting in touch with clients not linked up by private sidings, and their use should be extended.

However, the opinions of the various Administrations on the solution to be adopted do not agree, and those which do not wish to set up their own haulage ser-

vices nearly always fear that the haulage contractors will make use of such services to divert railway traffic to the road.

For this reason a certain number of Administrations favour creating companies affiliated to the railway which, in addition to dealing more directly with a large amount of road traffic than that brought in by rail or that intended for them, can in

Italy. — Rail-road trailer, of patented type, as used by « Servizio Materiale e Trazione » of the Italian State Railways.

Italy. — Rail-road trailer of the Italian State Railways carrying tram-car.

many cases lead to reciprocal compensation in the combined costs of road-rail transport.

Let us now consider the other techniques covered by the questionnaire.

In the previous chapter we saw that apart from containers which are used on the Spanish and Italian Railways and on trial in Portugal, no other system of door to door services apart from haulage services, and in Italy wagon conveying trailers, has been used by the Railways in Group II [1].

However, all railways agree that it is possible and desirable to extend the use of containers, first of all in the case of small consignments, and then also in the case of full loads, and the general tendency is to favour their use by private firms.

However the Railways themselves have made good use of them in many cases (for traffic passing through the customs, consignments of out-of-season vegetables, etc.).

The fact that all handling of the goods between the lorry and the wagon is made

(1) Naturally this only refers to the railways which replied to the Questionnaire.

unnecessary and the ease with which they can be loaded at the client's premises, makes them one of the simplest and best solutions for door to door services.

The use of small containers rather than large ones is becoming more and more general, since the latter are not usually very well adapted to the traffic and accompanying this Report will give some idea of its organization.

The high capital and operating costs as well as other difficulties encountered in their use (insufficient strength, and width of the roads and bridges, traffic congestion in the towns, etc.) would seem to prevent the general use of this method.

Italian State Railways.
Rail-road trailer brings a wagon to the client's door without difficulty.

require special equipment for handling them, when being transhipped from wagon to lorry and vice versa, which is not generally available at most stations (large cranes, motor cranes, etc.).

The wagon-conveying trailers, as has been seen, are not used by any of the Group II railways, except in Czechoslovakia on a small scale, and in Italy.

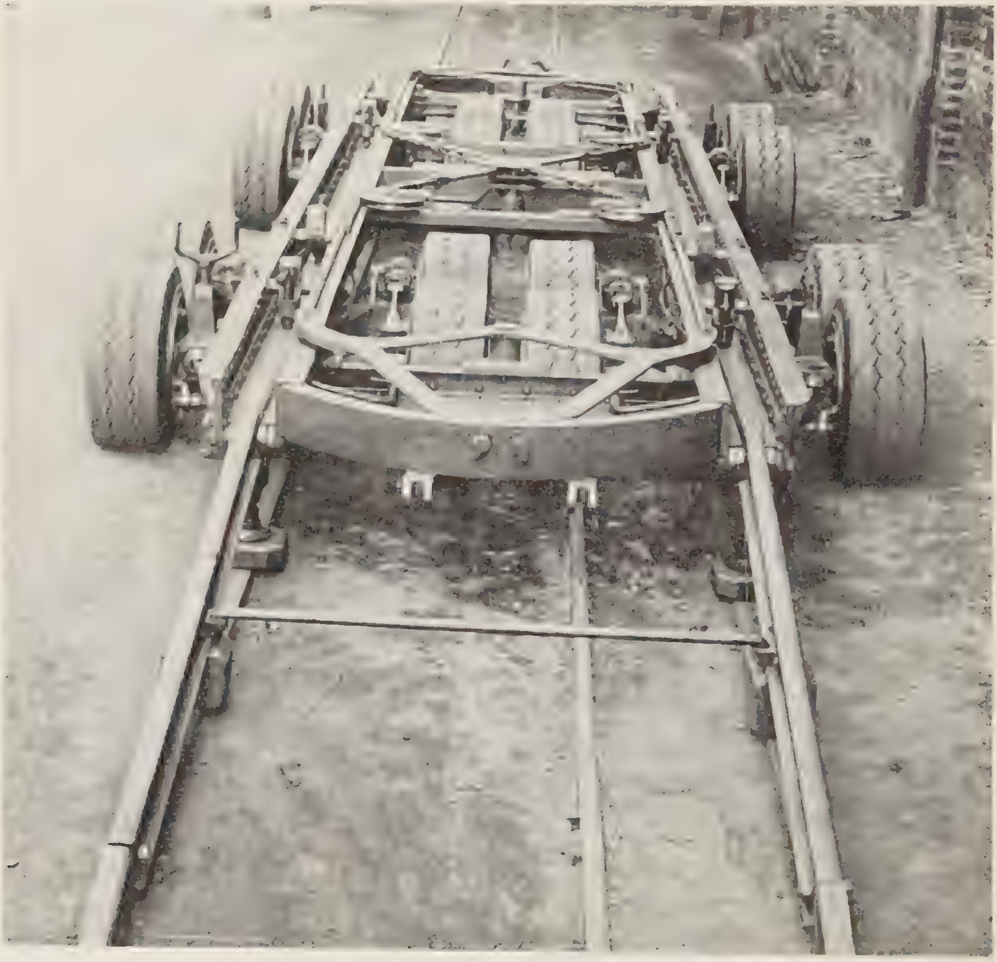
This method has been developped in particular on the Italian State Rys. and the description given in paragraph 2 of the previous chapter and the photographs

Rail-road trailers are not yet used in any of the countries in Group II, although in our opinion they are destined to develop very rapidly once the magnificent results obtained by their use in the countries in Group I (see report of our colleague M. GIRETTE) become generally known.

On the other hand, the capital and operating costs seem to be lower than those of the wagon-conveying trailers, and they combine the advantages of the former with those of the container, especially when the trailers are privately owned.

The other techniques mentioned, such as pipe lines, etc. pneumatic conveyors, conveyor belts, overhead lines, etc. and finally mechanical methods of unloading goods at the station onto special lines and transporting them automatically to the consignee's premises, or vice versa, have only been developped in the Group II countries according to the extent of their economic development.

There is no doubt but that they constitute an effective method of fighting road competition in many cases, in addition to the facilities they procure in the stations.



Italian State Railways. — Mobile loading ramp on rail-road trailer.

But although they may contribute to a large extent in retaining traffic by full

loads for the railway, the fact is that many circumstances have made it impossible for the Group II countries to make use of them so far.

It would appear desirable therefore to concentrate upon other methods intended to retain both the full load and small consignements traffic on the railway, which come under two main categories : those concerned with carrying out the transport under the best possible conditions (speed regularity, safety, etc.), and those aiming at increasing the facilities enjoyed by clients in the stations to enable them to carry out loading and unloading as cheaply as possible.

As will be seen from the previous chapter, the Group II countries have done a great deal to improve the transport conditions under the different headings given above.

The development of privately owned special wagons is encouraged everywhere.

This is another very effective way of meeting road competition.

Finally it will be seen from the replies received that the steps taken in the different countries in Group II as regards renting sites in the stations have the advantage of retaining railway clients without involving such high expenditure as does the construction of private sidings.

These are however an excellent solution for door to door services, but they are not always practicable for technical or economic reasons.

As a general rule, the Railway does not deal with the loading and unloading of full loads, although in many cases the classical equipment (cranes and gantries), with which most stations are equipped for dealling with small consignments, is used for this purpose.

Italian State Railway.
The mobile ramp is removed from the track by means of a small turning crane.

Only the Mozambique Railways, in view of their special operating conditions, have provided special equipment at the ports to facilitate transhipment.

As all techniques and methods reported are well known to most of the Administrations, if not from their own experience, from the copious literature on the subject, we will now deal with the question from its general aspect.

Italy. — Rail-road trailer carrying tank-wagon negotiates a right-angled curve with ease.

B. Final constatations.

The wording of the question under discussion shows the acuteness of the present railway situation.

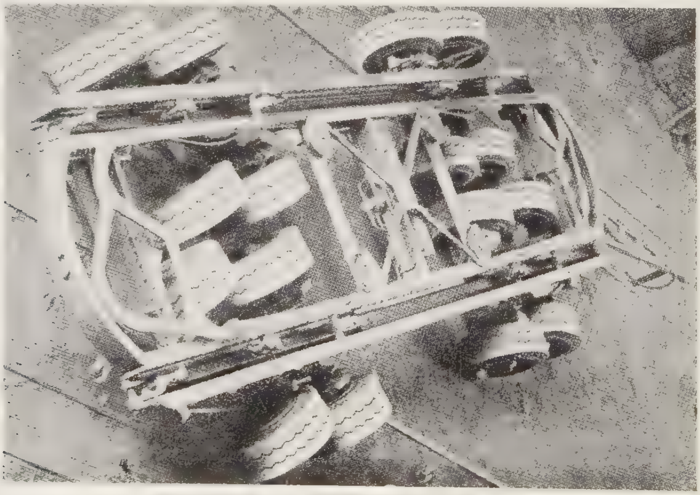
The advantages of transporting large masses and of transport over long distances by railway, an axiom formerly indisputable, would seem to be shaken to its foundations, and already road competition has made it necessary to study the best methods of retaining traffic in full loads on the railway.

Must it be concluded that the advantages of railway transport have been surpassed by road transport ?

Only a searching examination of the question can give a definite answer on this point.

Before dealing with the various aspects of the problem which seem to us the most important, we will endeavour to give a summary of the present position.

Let us consider first of all the transformation which transport has undergone since the 1939-45 war.



Italy. — Monobloc rail-road trailer as used for door-to-door transport.

Railway traffic, which increased to a considerable extent in many countries during the war for various reasons, and fell off in others, generally showed a marked increase in nearly every country at the end of the war.

As after the 1914-1918 war and the world economic crisis which followed soon afterwards, the general tendency everywhere was to make good some of the devastation wrought so that ordinary life could be resumed.

This involved a tremendous reconstruction programme, and the Railways profited by it in many countries to improve their installations, whereas in others this still remains to be done, since peace has not really arrived.

In some countries the war, in others the official end of the war, led to an « invasion » of motor transport which largely exceeded their economic requirements.

Meanwhile a new world crisis arrived, this time much quicker than anyone could have foreseen.

From the economical point of view, this crisis is the cause or result, no one can say which for sure, of restricted imports and exports, sudden changes in the monetary conditions of each country, and a whole series of other well known difficulties. This crisis does not yet appear to have reached its peak.

The examination of the transport problem therefore suffers from the present state of confusion throughout the world.

However consideration of the superabundance of motor transport in many countries will explain the main cause of the railway crisis as regards transport.

This increase in the number of motor vehicles and their loading capacity is at the basis of the re-emergence of competition, both in the case of small consignments and full loads.

At the present time the road hauliers are charging ridiculously low prices for road transport in many countries, because they must live, and receipts are necessary at no matter what cost.

It appears likely that in a few months or a few years the situation should change; we await this and live in hopes, but in the meantime the plight of the railway is becoming more and more serious owing to this extravagant competition.

Moreover the large industrial firms seeing the great progress made in motor technique during the last few years have not hesitated to buy heavy lorries, whose loading capacity in some cases exceeds that of a railway wagon.

Such purchases are encouraged by the complete freedom from restrictions enjoyed by private transport in nearly every country.

The fact is that the large capacity lorry running on direct and easy routes is at the present time a formidable competitor of the Railway, especially in the case of full loads, although it also takes the small consignments by grouping them carefully.

It must not be forgotten that the average percentage of full load traffic compared with the total goods traffic carried by the railway is about 75 %, which makes the actuality of the problem under discussion clear and shows the need for viewing it boldly.

On the other hand the « after the war » feeling has led to a lack of balance in living which requires special effort and courage to meet day by day all the difficulties which arise, often for no reason at all, to menace the foundations of our civilisation.

This has given rise to a general uneasiness which shows itself in everything, and the Railways naturally have also been affected by the reduction in their output.

Nevertheless the quality of the services offered to the public has returned to its pre-war level in nearly every country.

Slowly but surely the Railways have also improved their technique and the admirable esprit de corps of the railway staff has stood up to all their difficulties and troubles.

Let us hope that this spirit, developing

to an ever greater extent, may contribute, with the assistance of suitable instruction, to an improvement in the Railway services.

It is not in the countries in Group II that we must look for detailed studies on the subject of the organisation of door to door transport of full loads, since in nearly all these countries the problems covered by the Questionnaire do not arise as yet, in view of their different operating conditions depending above all on their physical and economical geography.

Most of the Administrations consider moreover that whatever the solution to be adopted, it would not prove effective without legisation dealing with transport to make sure that the long distance and bulk transports are mainly assured by the railway.

There is no point in reiterating the reasons for this opinion, which have been the subject of many studies and discussions.

However, it should be enough to mention the fact that the railways are subject to the obligations of a public service and to consider the commercial and extra-commercial burdens imposed on them, and, from another point of view, especially in the case of the transport of full loads, the damage done to the roads by the transport of large masses, to convince all those who are completely impartial, of the justice of the Railway's claims.

Consequently it is necessary in a great many countries to consider revising the legilation affecting road transport in order to obtain a proper equilibrium in the division of the traffic, taking into account the economic requirements of each country.

To make it acceptable, for psychological reasons, such a revision should be preceeded by measures to restore the confidence of the public in the railway.

The Railway has in itself vast resources which have already been proved, and the ingenuity of its techniques will once again bring out the importance and indispensability of this method of transport.

In the commercial field, the fact of being a public service on the one hand, and, on the other, the purely commercial outlook, make it necessary to be all the time on the alert in order to supply the transport conditions required by the economic needs of the time and, in addition, to adapt closely the transport rates to these same needs.

In the field of technical operation, the present tendencies towards lightening the stock, the reduction in the number of types of wagon, the adaptation of the wagons to fast running, will certain make it possible to perfect the methods of transport, which will lead to the desired results, i.e. the improvement of the railway goods services.

If in the case of door to door services each country must study the adaptation of both the railway and road stock as regards tonnage and capacity to its own commercial requirements, it must not be forgotten that in order to achieve the desired results it is necessary, and even indispensable to have intelligent commercial management.

This deals above all with the rates and with improving the technical conditions under which transport is carried out, involves perfect liaison between the Commercial Service and the Traffic Service, with further important aspects which this Report cannot deal with in detail.

However the references that have been made to them show that it is essential, in our opinion, to interest the staff more and more in the development of the traffic by appropriate measures.

In the case of goods traffic, both small consignments and full loads, it is necessary above all to speed up the transport, simplify formalities, and give door to door transport.

The experience of the countries in Group II not being very extensive as regards the proposed question, we think it best to limit our summaries to the following general ones.

* * *

CONCLUSIONS.

1. The large volume of full load traffic compared with the total goods traffic as well as the importance of the respective receipts make it necessary to exercise ever greater vigilance in order to prevent it being lost to other methods of transport, and especially to road transport.

2. Since the organization of terminal transport of full loads is one of the most effective methods of retaining such traffic on the railway, it is essential that this organization should be based on the economic requirements of each country, and be preceeded by a minute study of these requirements; a careful check should be kept of their evolution.

3. If from the technical point of view the railway is certainly evolving towards the development of door to door services which will lead to an ever increasing extension of the use of containers and rail-road trailers, the other methods now used (haulage services and wagon-conveying trailers) are sufficient at the present time and should remain so for a long time, to cover all commercial and industrial needs, as well as that of agriculture, as regards the door to door delivery and collection services.

4. From the commercial point of view, it is necessary to obtain faster transport of the goods and better adaptation to the requirements of the public.

To improve the quality of the service should therefore be one of the permanent objectives of the Railway.

5. Suitable commercial relations with industry and trade and similar relations as regards production and agricultural exchanges are to be recommended.

In these relations intelligent pursuit of new goods traffic, propaganda and commercial publicity should have a pre-eminent place.

6. To assure the long distance and bulk transport of goods by rail an even the respective terminal transport of full loads and in order to offer better service to the public, the competent authorities should regulate road transport, taking into considerations the burdens which fall upon the railway and do not touch the road, the railway's character of a public service, and the advantages which it gives to users of the door to door services set up in close collaboration between railway an road.

7. It is desirable to arrange for the technical training of the staff in order to interest it in the development of the traffic and to create a tenacious spirit of economy, devotion and courtesy which will contribute very largely to the general improvement of the services for which it is responsible.

* * *

APPENDIX.

CONTRACT

between the Greek State Railways (C. E. H.) represented by

....

and

....

to

....

regarding the haulage services.

The C. E. H. hereby hand over to the contractor .... the haulage service at .... station on

the following conditions:

1) The haulage contractor assumes the responsability of—

   (a) carrying to the premises of consignees and delivering to them the goods handed over to him by the goods services at .... station

   (b) collecting from consignor's premises goods intended for transport by rail, transporting them to the station, and handing them over to the goods services.

2) With regard to collection of goods at consignors' premises, this shall cover all consignments of all categories (part- or full loads) for any kind of goods service; it shall also apply to all articles except those expressly excluded by the tariff.

3) In order to insure the haulage services, the contractor must have available a sufficient number of motor lorries of the appropriate type, which may be either owned or hired by him for this purpose. The lorries used must in addition meet the following conditions, and responsibility for this shall rest with the contractor :

   (*a*) be licensed for the road;

   (*b*) be assured for the whole period of the present contract with an Assurance Company against fire, accident, etc.;

   (*c*) be equipped with the necessary loading tackle.

4) The contractor shall carry out the haulage service with all due diligence; he shall be responsible to the C. E. H. for all irregularities arising, particularly delays, total or partial damage or loss, to any of the goods being carried. The C. E. H. shall have a right to claim against the contractor for any damages paid under this heading.

5) Should the times fixed by the C. E. H. for the collection of consignments be exceeded, the C. E. H. has the right to collect those consignments using other methods of transport. The sums paid out in this connection will be recoverable from the contractor.

6) In carrying out the haulage services, the contractor shall exercise due diligence. He shall be responsible to the railway for all irregularities, such as delays, partial or total loss or damage, occuring during the haulage. The railway shall have the right to recover from the contractor any damages it may have to pay which are imputable to the above mentioned causes.

7) The handing over of goods by the railway to the haulier and vice versa shall be effectued by waybill upon which shall be written any observations or remarks concerning the condition of the goods. If no such observations or remarks are entered, it will be assumed that the goods were handed over in good order.

8) The C. E. H. has the right to have their goods accompanied by their own staff if they so wish during haulage, and to give to the haulier any instructions they deem necessary through their staff; any such instructions shall be respected by the haulier.

9) The C. E. H. undertake to pay the contractor the following sums :

   A minimum charge per .... kg will be paid per consignment.

10) The accounts will be checked and paid monthly by the C. E. H.

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INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

15th. SESSION (ROME, 1950).

QUESTION XI.

Organisation and development of medical and social services with partnership of the staff in their management.

REPORT

(Great Britain and North Ireland, Dominions, Protectorates and Colonies, America (North and South), China, Burma, Egypt, India, Pakistan, Malay States, Iraq and Iran),

by P. H. Sarma,

Director of Wagon Interchange and General Secretary, Indian Railway Conference Association, India.

I. — Introductory.

The questionnaire jointly drawn up by Dr. Huyberechts and the reporter was sent to 26 Railways. Of these, 15 Railways failed to respond and 4 Railways expressed their inability to give the answers in detail owing to other preoccupations. Detailed replies were, however, received from British Railways and London Transport Board, Pennsylvania, Ceylon, Indian, Malayan and Sudan Railways and this report has been based on the information furnished by these administrations.

The reporter would like to convey his thanks to his colleagues for the care and time devoted in preparing the replies to the questionnaire in spite of serious handicaps, shortage of personnel and other difficulties.

II. — Social Security Laws.

Both in England and America, statutory laws are provided for social security, collective and mutual help. It is compulsory for most workers. In Great Britain, the National Insurance Scheme came into operation on the 5th July 1948. It provides in return for regular weekly contributions, cash benefits during sickness, injury, unemployment and pensions for industrial disablement and on retirement from regular work. This scheme is compulsory and has taken the place of the former Unemployment Insurance, National Health and Contributory Pension Schemes, and the Workmen's Compensation Acts. The money to be paid for these benefits comes partly from weekly contributions by insured persons and employers and partly from payments out of taxes. In general, everyone over school-leaving age living in Great Britain became insurable as from the 5th of July 1948. In America, the compulsory social security scheme was created in 1935. It is applicable to most workers. The largest groups excluded are only the agricultural workers. Workers are paid old-age

benefits after retirement, usually at the age of 65, and widows, children and dependent parents of deceased workers are paid benefits. These benefits are financed by contributions of both employers and employees based on the wages paid. Unemployed workers are paid benefits which are financed by contributions of the employers alone. Aid to the needy, aged and children and to the blind is provided by suitable contributions from the federal and state treasuries. There have been no major changes in America, although increased coverage and benefits are now under consideration while benefits paid to Railway workers have already been increased.

In India, though no general Acts giving similar benefits have been enacted, yet Railways have instituted a system of compulsory provident fund and gratuity to all employees. Each employee must subscribe one-twelfth of his monthly emoluments and the Administrations contribute an equal amount. These accumulate at the prevailing rate of interest and, at the end of the service, the total amount due is further supplemented by a gratuity varying according to the total service performed and the salary he draws at that time.

Workmen's Compensation Act is statutory in all the countries that have submitted replies, viz., Great Britain, the United States, India, Ceylon, Sudan and Malaya. Certain workers including Railway employees, are covered by legislation which defines the liability of the employer in certain circumstances. The basic concept is that of insurance, financed by employers, subject to the laws, so as to shift the burden of the economic loss resulting from injuries from the employees to the industry. Compensation paid varies according to the loss of earning capacity sustained by the injured workman.

In America, workmen's compensation laws were first enacted in various states from 1908 to 1915 and are now generally in effect throughout the country.

In India, the Workmen's Compensation Act was first brought into force in 1923; in Malaya, in 1929; in Ceylon, in 1934 and in Sudan, in 1949. No major changes in principle have been made since World War II, except that the amounts of compensation paid to the workers have been enhanced in accordance with the increased cost of living.

In the United States, similar laws apply, although the railroad workers fall under a group of special laws, similar in theory to the general system, but providing greater benefits at a greater cost to both employers and employees and they are supplemented by the Voluntary Relief Department and the Supplemental Pension Plan. The Voluntary Relief Department was organized in 1886 and pays sick, accident and death benefits, the amount depending on the rate of contribution. The administrative expenses are borne by Railways. The Supplemental Pension Plan was brought into force in 1938 and provides pensions on amounts earned in excess of 300 dollars per month and varies according to the total railroad service performed.

In all the countries, the employees obtain the benefit of free treatment in Government hospitals. In India, although medical aid for citizens is a state responsibility, the Railway Administrations have been interested in the health of Railway servants both from the point of view of reducing to a minimum absence of their employees through sickness and as an amenity to the staff. The aim of the Administration is :

(1) to provide for the preventive side of health measures so that the incidence of sickness among the staff and the periods of absence from work are minimised;

(2) to ensure that the staff get adequate treatment in the case of sickness, so that they can resume work and maintain their productive capacity;

(3) to ensure that staff are medically fit both at the time of entering the service and periodically, such fitness being necessary in the interests of safe working of trains and to meet other special conditions under which Railway employees work;

(4) to provide medical facilities for the families of Railway servants so that Railway servants themselves, specially those who have to be away from their homes on duty, need have no anxiety about the health of their families.

III. — Medical and Health Organisations

The British Railways do not, as a general principle, undertake the duties of Personal Health Service for their employees, as these are already provided under the National Health Service Act both for the Railway employee and his family. There is thus a fundamental difference in practice between British Railways' Medical Services and those which operate in other countries. The Chief Medical Officer of the British Railways is responsible for all medical matters to the Member of the Executive for Staff and Establishment matters and directs the medical service with the assistance of the Regional Medical Officers. In some parts of the country, particularly in the rural areas where the staff is scattered and the number is comparatively small, it has been the practice to make use, on a per capita basis, of the services of general practitioners. In some instances it has been found advantageous to employ a medical examination coach, the use of which provides a mobile medical centre which can be sited according to the requirements of the situation, and which provides proper accommodation specially designed for the purpose. The Railway Medical Service deals with accidents occurring at work and is also concerned with the conditions of welfare and health of Railway employees when at work. The National Health Service, however, caters for the conditions of health at home and makes suitable provision for a man and his family in retirement. A chart of the medical organisation on British Railways is shewn below :

BRITISH TRANSPORT COMMISSION

RAILWAY EXECUTIVE

STAFF MEMBER
OF RAILWAY EXECUTIVE

Chief Medical Officer

Regional Medical Officer (6 Regions)

Assistant Medical Officer

Works Medical Officer.	Area Medical Officer	Part-time Medical Officer (where necessary).

On the Pennsylvania Railroad, medical officers are available at important places where medical and surgical attention is available approximately 8 hours each day. In addition, there are many sub-offices where this attention is available on a restricted basis. Company Surgeons are available in large towns on the line to attend to emergent cases.

In all countries, Railway employees are treated like Government servants and given free treatment in Government hospitals.

In India, however, a separate Medical Department, working directly under the General Manager, is responsible for the general health and the running of the hospitals under him. Specialised staff, viz., Physicians, Surgeons, Nurses, etc., are appointed to man the hospitals. Recruitment to the Senior Officer Cadre of the Medical Department is done by the Union Public Service Commission while other technical staff are recruited by an independent Railway Service Commission. These Commissions usually have a very senior technical officer to judge the standard of recruitment.

On almost all the Railways, welfare work is independent of the medical services and is directly under the supervision of the officer responsible for establisment.

IV. — Medical.

As mentioned above, in all countries railwaymen obtain health benefits under the National Health Services. They obtain necessary medical aid from Government hospitals.

In India, railwaymen obtain the privileges of Government hospitals. Besides, Railways also provide separate medical services to all their employees. There are well-equipped district hospitals every 1 000 miles of the Railway, with competent full-time district medical officers. All Railway employees obtain free medical assistance in these hospitals. The number of beds provided varies according to requirements in the different areas. At the headquarters of each Railway, well-equipped hospitals exist and facilities for special treatment are also given. Almost all hospitals have X-ray equipments with up-to-date operating theatres as also well-maintained in-patient wards. The assistants attached to District Medical Offices go out on line on fixed days to attend to sick employees and their families and, in serious cases, the workmen are taken to the nearest hospital. Free travel facilities are given both to employees and their dependent family members to obtain medical facilities from the nearest hospital. The extent of the medical attendance and treatment afforded by the Railway Administration may be briefly stated as follows :

(i) In addition to all medical and surgical facilities available, the employment of pathological, bacteriological, radiological and other methods for medical examination and treatment.

(ii) Free consultation with specialist under certain circumstances.

(iii) Free accommodation, etc., in a Government or private hospital where no accommodation is available in a Railway hospital.

(iv) Supply of medicines not ordinarily available as may be certified to be essential.

(v) Free attendance and treatment of families of Railway servants in the same way as in item (iii) above.

(vi) Special nursing.

(vii) Free medical attendance and treatment of female members of Railway servants' families in specified Railway hospitals.

(viii) Ambulance attached to District Medical Offices is available free of cost to the staff.

On certain Railways in India, mobile medical vans are run on branch line sections to serve the needs of Railway staff in rural areas. The Railway hospitals are directly managed by the Railway Administrations, but there is an Advisory Committee consisting of representatives of the staff of different grades who frequently visit the hospitals and make recommendations of a general nature for improving the facilities and arrangements provided. Rail-

ways quite often engage eye and dental specialists to go round the various centres on appointed days in order to give treatment to staff and their family members and provide them whenever necessary with glasses and dentures at a nominal cost.

V. — Social.

The social activities in almost all the countries are more or less the same. Dancing, music, dramas, picnics form the general trend of social activities among railwaymen.

On the Pennsylvania Railroad, the administration does not directly promote these activities. The staff who are interested in the different activities form clubs of their own and are financed by the interested employees through their organizations.

In England, the Railway Executive gives assistance in the form of direct grants, loans at low rates of interest, lease of land at low rentals and free legal assistance. The social services are administered by a committee of the staff on which the management is represented. There is no uniform system of social activities on the British Railways. They vary from region to region. It has been the practice of the management to make a contribution annually to the funds of the Staff Association. Almost all the Railways provide facilities for all the social activities. Club Houses, Institutes, playgrounds are the general form of contributions made by the Railways. Except on the Sudan Railways, the staff on all other Railways contribute to the running of these activities supplemented by grants by the Railway Administrations. The activities are invariably conducted by members elected by the staff and the Administration nominates one or two officials to ensure that the activities are conducted in a proper manner.

VI. — Entertainments.

All the Railways, except the Pennsylvania Railroad, report that music and dramatic parties are organized by the Entertainment Committee of the various Institutes and Clubs. They are controlled and run by the staff themselves. The expenditure on these items is usually met from the contributions from the staff and from the Administrations. Majority of the Railways give free travel facilities to staff to attend the entertainments arranged by their Clubs.

On the Indian and Malayan Railways, various Clubs arrange cinema shows at frequent intervals free of cost. On the Sudan Railways, a cinema runs twice a year to exhibit films of educational nature.

VII. — Sports. — Physical culture.

On all Railways, except the Pennsylvania, staff associations, athletic or sports clubs have been formed to promote active interest of the staff in outdoor games. On the British Railways, the staff associations are formed on a regional basis. Special grants or loans to individual clubs at low rate of interest to be repaid over a period of 10—20 years are made. Lands are leased at nominal rents. The membership is open to employees both in service as well as after retirement. A separate Women's Section is also formed for the convenience of women. The subscription is very nominal. The members are encouraged to take part in annual competitions, embracing indoor and outdoor sports. One of the association's activities is the « Helping Hand » Fund which provides help to needy railwaymen and their families. The Railways' Athletic Association, formed in 1947, promotes athletic sports amongst the Railway employees and arranges championships on an individual and inter-regional basis.

In India, individual Railway Athletic Sports Clubs conduct regularly Inter-Divisional or Inter-District athletic sports as well as outdoor games like football, hockey, cricket and tennis. Playgrounds and sports equipment are provided by the Railways to these clubs free of cost. There is also an All-India Railway Athletic Association which conducts annually athletic sports on an All-India basis in which staff from the various Railways take part. This is modelled on the lines of Olympic Games wherein competitors of each individual Railway are given points thereby inculcating the spirit of competition between the different Rail-

ways operating in India. Similarly, competitions are arranged for outdoor games like football, hockey and tennis. Tournaments of this nature have promoted a healthy spirit and have created an enthusiasm amongst the staff to take an active part in games. Free travel facilities are given to all staff participating in these tournaments. Railway players are also encouraged to represent India in the world Olympic and other International tournaments.

Similar athletic and sports activities are conducted in Ceylon and Malaya.

VIII. — Education.

Except on the Pennsylvania Railroad and Ceylon Railway, Railways provide special training centres for suitable men to take training in the various Departments of Railway working, specially in Mechanical Workshops and Traffic Training Schools. These are solely intended for the benefit of the staff who like to better their prospects. The dependent family members of the staff are not normally allowed to attend these professional institutions. In some regions of the British Railways, they have these institutions but not in sufficient number to cater for the whole of the staff. In the near future they expect to have an adequate complement of schools. The organization is in the process of building and is as yet incomplete. There is a Training and Eduction Officer attached to the Department of the Chief Officer (Establishment). As a part of the Headquarters training and education organization of the Railway Executive, there has been established a Joint Training and Education Advisory Council between British Railways and the Trade Unions concerned, in order that there may be the closest co-operation with the Trade Unions for the development of educational arrangements for the Railway staff. The staff are represented through their Trade Unions on the Joint Training and Education Advisory Council which advises the Railway Executive on the development of the programme.

In India, however, apart from these professional training institutions, schools for the education of children have been provided at large Railway Colonies which are situated far away from important cities. These institutions are run and financed by the Railways. In certain cases arrangements are made with other approved educational institutions for the admission of children of Railway employees and grants in aid are made from Railway revenues. Where there are no schools of the requisite standard, financial assistance is given to employees to meet a portion of the expenses both on board and tuition for the education of their children at schools away from stations at which the employees are posted. The assistance given varies, depending upon the pay of the employee, and is limited to education for the period covered by the primary, middle and high school standards. For staff coming under lower category, educational assistance is, however, given from the Staff Benefit Fund. Free passes are also granted for railway journeys of the children of all Railway employees to and from their schools situated at outstations to visit their parents or when appearing for their examinations. The schools at the various centres are open to dependent family members of the Railway staff and are well patronized.

Similar institutions are also provided by the Sudan and Malayan Railways.

IX. — Catering.

On almost all the Railways, canteens are provided at important stations where circumstances justify. They are usually established at stations where there are large concentrations of staff. No minimum number is fixed, it being dictated by the needs of circumstances. Normally, they are managed by the staff, but occasionally at certain places, the Railway Administrations themselves run the canteens. Generally, the Administrations provide the building and equipment free of cost. Buildings are maintained externally but equipment is replaced by the Canteen Committee where this is the controlling authority running the canteens. Electric current consumed for heating and lighting is usually paid for by the Canteen Committee; but, in certain cases, Railways bear this expense. In other

cases where these are managed either by an outside contractor or by the Railways themselves, it is the practice to have an Advisory Committee or a Liaison Committee elected from the users of the canteens. The function of the Committee is to discuss, with the management of the canteens, any complaints or suggestions which may arise. The Railway makes periodic checks to ensure that the canteens are run on a satisfactory basis and, on certain Railways, it is the practice that a representative of the Administration is on the Controlling Committee. Except on the British Railways, many Railways provide employees stores on a co-operative basis. On all Railways hostels are provided at certain centres to accommodate staff who, owing to their duties, are unable to return home the same day. Free sleeping accommodation is provided, except on the British Railways where a charge of 1 sh. per night is levied. Meals are provided on payment.

X. — Welfare.

The nature of welfare work differs in different countries. On the Pennsylvania Railroad, welfare work is done generally by an organization known as the Women's Aid. The Railway Administration does not exercise control over this organization and it is administrated by the employees and members of their families. Monetary or material aid is given to the needy staff when it is warranted. They provide baskets of food to needy families during Christmas time.

On the British Railways, matters concerning the safety, health and welfare of the staff are dealt with by a Joint Welfare Advisory Council composed of 10 members representing the Railway Executive, the National Union of Railwaymen, the Railway Clerks' Association, the Associated Society of Locomotive Engineers and Firemen and the Employees' side of the Railway Shopmen's National Council. The Council makes recommendations to the Railway Executive and is responsible for keeping under constant review the general welfare of all grades of the staff, including such matters as amenities in workshops, offices, canteens, messrooms and hostels, hygienic facilities, the welfare of women and junior staff, social and recreational facilities, accident prevention and first aid. The Council considers the relative priority of schemes submitted to it and recommends the order in which they should be carried out. It has prepared standards of accommodation for the staff which will be introduced as and when circumstances permit.

On Indian Railways, welfare organization is a separate branch, working under the Chief Officer of the Establishment. He has under him a certain number of junior officers and inspectors who tour the various areas in their jurisdiction and ascertain from the staff their needs pertaining to general welfare. They supervise the canteens and messrooms and hostels. Welfare Committees, consisting of representatives of staff, function at every District or Divisional Headquarters, and are responsible for keeping the staff quarters and their surroundings in hygienic condition and general upkeep.

Except on the Pennsylvania Railroad, Railway Benevolent Institutions or Staff Benefit Funds are provided. On the British Railways, the Railway Benevolent Institution is maintained largely by voluntary subscriptions and although the Railway Executive is not responsible for its administration, it takes a very close interest in the activities of the Institution. In other countries, separate funds are allotted for the Staff Benevolent or Benefit Fund from which contributions are given to the needy staff. Besides, on many Railways in India, Malaya and Sudan, staff are encouraged to form Thrift or Co-operative Societies from which staff can obtain loans on easy terms with the privilege of paying the loan through their salaries. On the British Railways, 2 orphanages for children of Railwaymen exist, while in India many special Maternity and Child Welfare Clinics and T. B. Clinics are run by the Railways.

XI. — General remarks.

All the countries that have reported consider that their existing practice and system, general welfare and medical facilities are quite adequate and satisfactory.

[656 .25]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

15th. SESSION (ROME, 1950).

QUESTION IX.

Modern safety and signal installations (centralizing apparatus for block system and signals). — Central electric apparatus with individual levers and « all relay » levers (all electric interlocking). — Automatic block-system with continuous current and coded current. — Light and speed signalling.

REPORT

(Belgium and Colony, Denmark, France and Colonies, Luxemburg, Norway, Netherlands and Colonies, Poland, Switzerland and Syria),

by Ir. E. J. F. Derijckere,

Director of Electricity and Signalling Department, Belgian National Railways.

Certain questions dealing with matters of principle and the methods of putting them into effect, relating to the points set forth above, having already been raised at previous Sessions, the questionnaire for submission to the present Congress has been drawn up principally with a view to being applied to electrified lines or to lines which are to be electrified.

At the present time when certain railways propose to invest large capitals for the purpose of electrifying their lines, while at the same time increasing the speed of their trains, we have been considering the development of colour-light signalling and its adaptation to this new method of working. In addition, the increase in the density of the traffic which will result makes it necessary to look for means of obtaining very great rapidity in the setting up of routes in the signal boxes, while employing a minimum of staff and at the same time obtaining the maximum degree of safety.

Certain questions referring to the technical details of equipment design, either in the signal box or out on the line, have also been brought forward for consideration.

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The questionnaire was sent to Railway Administrations in the following countries :

Algeria;
Belgium and Colony;
Denmark;
France;
French Colonies & Protectorates;
Luxemburg;
Norway;
Netherlands & Colonies;
Poland;
Switzerland;
Syria;
Tunis.

All have replied, except Poland, either by giving very valuable detailed information which will be set forth below, or by saying that the state of development of their railways is not such as to justify as yet the installation of such an advanced type of signalling as that which will occupy us in the present report. We wish to express our thanks at this point to the engineers concerned on these different railways for the kindness and readiness with which they have supplied us with the particulars on which our report is based.

We propose to divide the report into four parts and to retain and comment on the useful replies which we have received. In doing this we shall, in principle, take the various railways in alphabetical order, introducing the replies with a commentary and following them with a conclusion.

CHAPTER I.

Light signals. Signalling for direction and speed.

1. *Do you find it necessary to give drivers direction indications? When do you do so, and how? What are the advantages?*
2. *Show by means of diagrams the aspects given by a series of signals and explain the meaning of these different aspects.*
3. *At a junction where the direction is signalled, the driver knows what direction he must take. With speed signals, he does not. Has it been proved that this is a drawback?*

ALGERIA.

The only junctions on the open line between stations on the Algerian railways are plain junctions, with two routes.

One line has a speed limit of 30 km/h. (appr. 19 m.p.h.) and on the other the maximum speed allowed on the main line may be observed.

The driver is informed of the route he is going to take by a reduced speed signal which, if turned so as to be invisible, indicates that the direct route is open and, if kept showing, that the turnout is to be taken.

At the outgoing end of stations the indication of the route set up is given in plain language by illuminated route indicators.

BELGIUM.

The geographical layout of the junction or entrance to a station is shown on an indicator board 300 m (appr. 328 yrds) in front of the signal itself. The *route set up* is shown next to this signal by a *luminous arrow* sign. The speed to be observed at the junction is given by luminous numerals showing the numbers of kilometres per hour in tens.

Where the speed is the same as that allowed on that part of the line no numeral is shown.

The same system is used for the outlet to stations except that the indicator board may be placed nearer to the signal.

N. B. — The principles and methods of applying this type of signalling will be found explained in the article « New colour-light signalling adopted by the Belgian National Railways for electrified lines fitted with automatic signalling or interlocked block » published by the author of the present report in the *Bulletin of the International Railway Congress Association* for January 1949.

DENMARK.

The indication of the route set up is given by a luminous vertical bar for the direct route and one inclined to the left or right to indicate a divergence in those directions. The Danish Railways propose, however, to supplement and possibly, in due course, to replace these route indications by speed indications.

FRANCE.

The French National Railways only consider it necessary to give the driver an indication of the route he is to follow, in cases where an indication of the speed to be observed is not in itself sufficient.

a) At an ordinary geographical type junction, with two routes only, one of these routes is ordinarily free to be taken at the maximum speed allowed on the line, the other at a lower speed, depending on the characteristics of the turnout.

In such a case an indication of the speed which must not be exceeded on the diverging route is considered to be a sufficient indication of the direction to be taken and the railway attaches no importance to whether a train is to be switched to the left or the right;

b) In the case of a similar junction but having more than two routes, where, for example, one line may be travelled over at the maximum speed of the line, the second at say 70 km/h. (appr. 42.5 m.p.h.) (and consequently signalled by means of a speed board) and the third at say 30 km/h. (appr. 19 m.p.h.) (and therefore signalled by a reduced speed reminder signal preceded by a reduced speed signal or a caution signal); the indication of the speed to be observed is also considered to afford sufficient indication of the route to be taken;

c) where in the case of an equal speed junction, or a junction including more than two directions, it is considered that an indication of the speed is insufficient to enable drivers to tell which route has been set up for them, a direction indicator is provided;

d) the indication of the direction to be taken is at times recalled to the driver's attention by means of boards inscribed in plain language placed ahead of the junction on each line. It sometimes occurs that these boards form the only indication of the route to be taken;

e) when one of the routes to which facing points lead gives access to a subsidiary line, such as an engine or carriage siding, there may be provided, in addition to the speed indication (or the direction indicator) or even as the only indication of direction, a board marked G (garage = siding). This board which is fixed, if placed ahead of the points, or made to revolve if in rear of them, either reminds the driver or, in the second case, indicates to him beforehand, that he is entering such a siding line (on which he must, of course, run prepared to stop short of any obstruction).

The French National Railways consider that the inherent advantages of using speed signalling to show the route set up are that it enables a reduction to be made in the amount of route signalling used and in the number of indications drivers are required to observe.

B. The Paris Transport Board *always* gives an indication of the route set up when a train has to take facing points at such a speed that the driver has no chance of stopping clear of the points if he sees from their position that he is being sent along the wrong route.

LUXEMBURG.

When the home signal shows « Proceed at unrestricted speed » for one of the routes at a junction and « Proceed at restricted speed » for the other, the Luxemburg Railways consider it superfluous to give an actual route indication, in view of the simple character of their railway system. They only indicate the direction to be taken at a junction when the signal itself gives one and the same speed indication for the two routes.

This is done by means of large letters formed of white lights, giving the initial letter of the next station ahead. These railways consider it useful to give drivers an indication of the route set up in order to prevent a train taking the wrong line due to a mistake on the part of a signalman.

MOROCCO.

Ordinary running junctions are signalled by junction semaphores with, should the circumstances require it, a speed board. At the outlet to stations luminous indication boards show which route has been set up.

NORWAY.

Direction is indicated on the Norwegian lines by giving the speed to be observed, as owing to the special layout of their railway system there are no running junctions between stations.

At the entrance to stations where a train can be received on more than one track numerical type signals are used.

NETHERLANDS.

The Dutch Railways consider that there is no need to indicate the route except at junctions where the speed is the same on both lines. In that case a luminous arrow sign might be used.

N. B. — The principles of the new Netherlands light signalling and their practical application were given in an article entitled « The destruction, rehabilitation and future development of the signalling on the Netherlands Railways » by Mr. J. H. Verstegen, Chief Signal Engineer of these railways in the *Bulletin of the International Railway Congress Association* for August 1948.

SWITZERLAND.

The Swiss Railways consider that in the majority of cases on their lines it is possible with speed signalling to indicate the route which is set up, direct or diverging. Where a speed indication alone is not sufficient to indicate direction, a direction indication board is provided.

***

In order to enable the reader to obtain an idea of the chief signalling systems in use we have illustrated in our report (Figs 1 to 5) the methods of applying the Belgian, French, Swiss, Dutch and Norwegian colour light signalling systems to certain types of junction met with in practice.

The meaning of the various indications given is as follows :

BELGIUM. S.N.C.B. (Fig. 1.)

1. Stop at the junction home signal.
2. Proceed at maximum permissible speed on the direct route.
3. Proceed on left-hand diverging route over points of ordinary type, maximum speed 40 km/h. (appr. 25 m.p.h.).
4. Proceed on left-hand diverging route over points of special type, say with spring pattern tongues, maximum speed 80 km/h. (appr. 50 m.p.h.).
5. Proceed on left-hand diverging route over special type points, maximum speed the same as for the direct route.
6. Proceed on right-hand diverging route over equal speed junction, or with points of special type, maximum speed 80 km/h. (appr. 50 m.p.h.).

FRANCE. S.N.C.F. (Fig. 2.)

1. Stop at the junction home signal.
2. Proceed at maximum permissible speed on the direct route.
3. Proceed on left-hand diverging route over points of ordinary type, maximum speed 30 km/h. (appr. 19 m.p.h.).
4. Proceed on left-hand diverging route, over points of special type, say with spring pattern tongues, maximum speed 80 km/h. (appr. 50 m.p.h.).
5. Proceed on left-hand diverging route over equal speed junction, with points of special type, maximum speed 80 km/h. (appr. 50 m.p.h.).

SWITZERLAND. (Fig. 3.)

1. Stop at the junction home signal.
2. Proceed at maximum permissible speed on the direct route.
3. Proceed on left-hand diverging route over ordinary type points, maximum speed 45 km/h. (appr. 28 m.p.h.).
4. Proceed on left-hand diverging route over special type points, say with spring type tongues, maximum speed may exceed 45 km/h. (appr. 28 m.p.h.).
5. Proceed on right-hand diverging route over ordinary type points, maximum speed 45 km/h. (appr. 28 m.p.h.).
6. Proceed on right-hand diverging route over special type points, say with spring type tongues, maximum speed may exceed 45 km/h. (appr. 28 m.p.h.).

NETHERLANDS. (Fig. 4.)

1. Stop at the junction home signal.

BELGIUM. *(S. N. C. B.)*

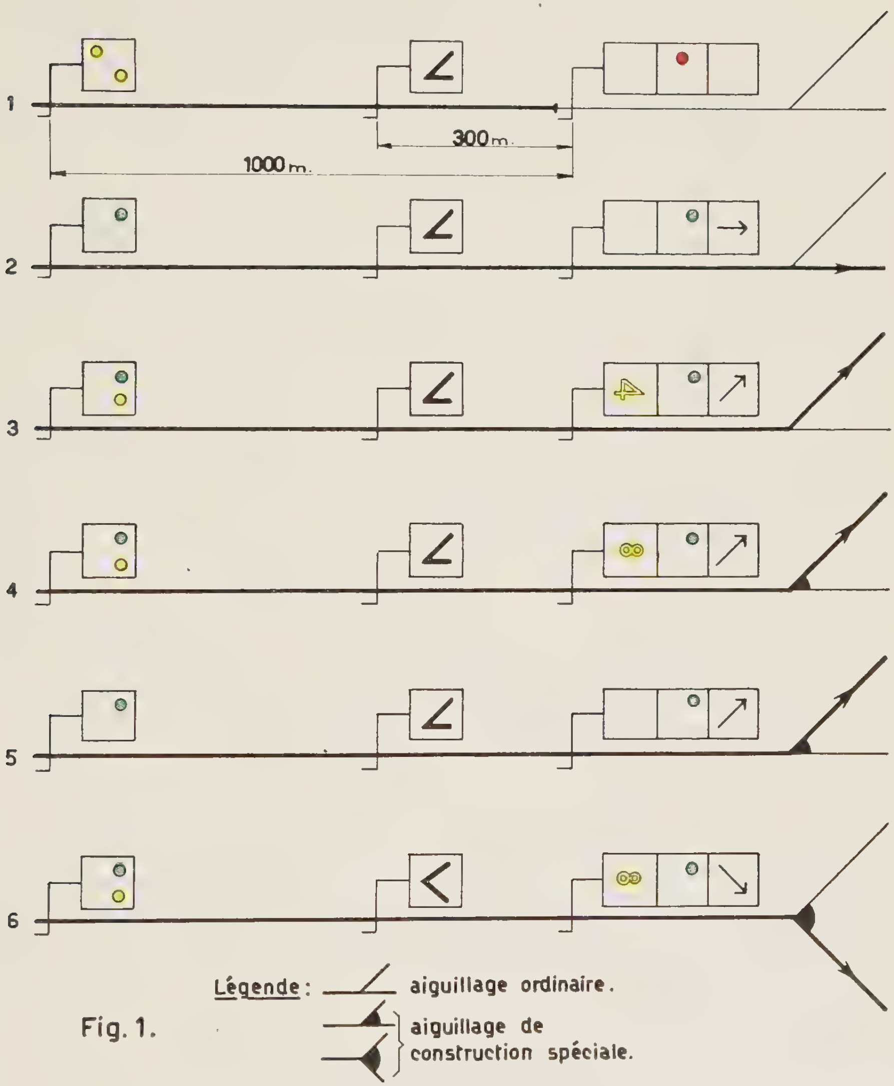

Fig. 1.

Explanation of French terms : Aiguillage ordinaire = Ordinary points.
Aiguillage de construction spéciale = Points of special construction.

2. Proceed at maximum permissible speed on direct route.

3. Proceed on right-hand diverging route over ordinary type points, maximum speed 45 km/h. (appr. 28 m.p.h.).

4. Proceed on right-hand diverging route over special type points, maximum speed may exceed 45 km/h. (appr. 28 m.p.h.) but must be less than that applying to the direct route.

FRANCE. *(S. N. C. F.)*

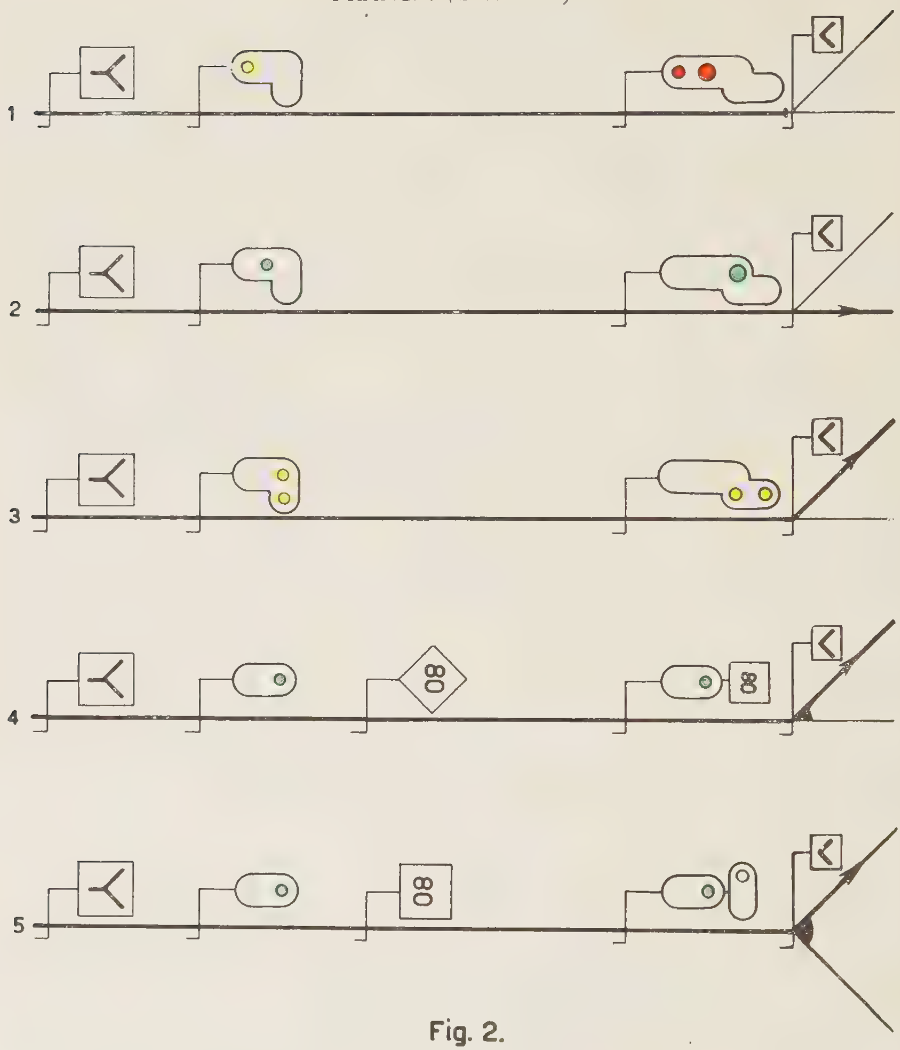

Fig. 2.

Légende: o **feu blanc**

Feu blanc = White light.

5. Proceed on right-hand diverging route over special type points, maximum speed the same as that applying to the direct route.

NORWAY. (Fig. 5.)

1. Stop at the junction home signal.
2. Run into station over diverging route.
3. Stop at the starting signal.
4. Run through station at maximum permissible speed.

N. B. — Lights A are normally out and are seen as white flashing lights when the

SWITZERLAND.
(Cie F. F., Emmental-Burgdorf-Thun Bahn, Rhätische Bahn, Bern-Loetschberg-Simplon.)

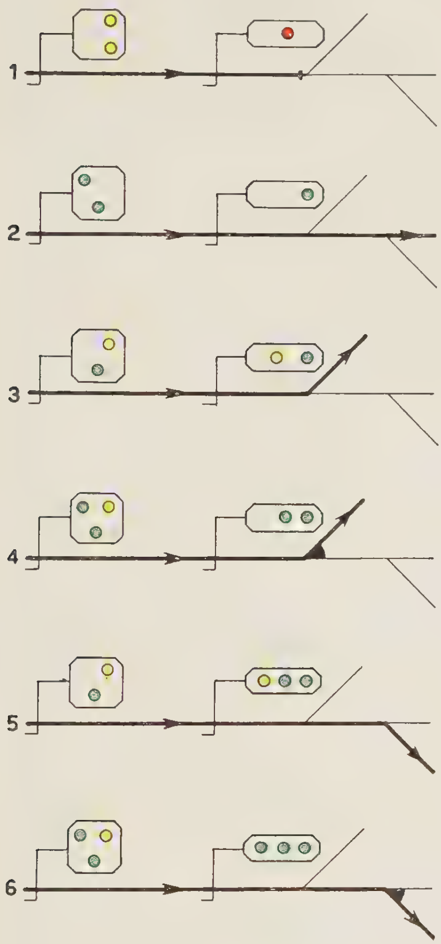

Fig. 3.

NETHERLANDS

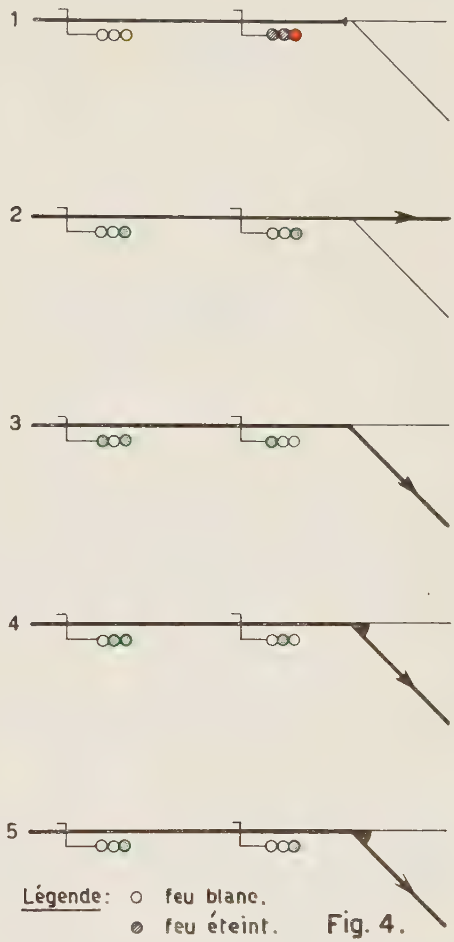

Fig. 4.

Feu blanc = White light. — Feu éteint = Light extinguished.

station is closed to allow trains to run through in either direction at normal speed.

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From what has been given above, the following conclusions may be drawn, namely :

1. All railway systems at the present time are adopting the red light in colour light signalling to indicate stop, either in rear of a junction or a station.

The multiple stop indications given by the bracket type signals on some lines are being given up. This is a matter for

NORWAY. *(Norges Statsbaner.)*

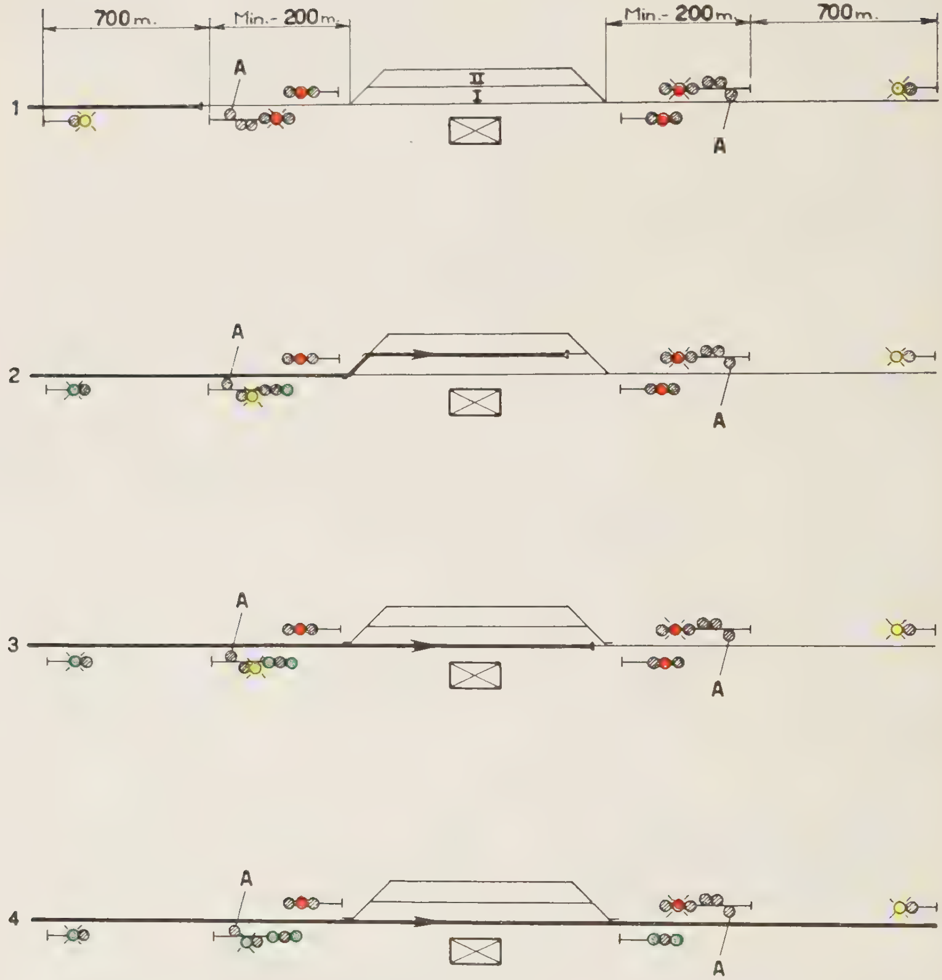


Fig. 5.

A : feu normalement éteint, qui devient blanc clignotant quand la gare n'est pas desservie et que la circulation se fait dans les deux sens sur la voie principale unique.

Légende: feu clignotant.
feu éteint.

Explanation of French terms : A : light normally extinguished, becomes flashing white light when station is closed and when traffic is allowed in both directions on single main line.
Feu clignotant = Flashing light. — Feu éteint = Light extinguished.

congratulation as it simplifies very greatly the reading at night of the signals at the entrance to the larger stations.

2. The caution indication, giving warning of the approach to a junction, is given either by one yellow light, or two yellow lights, or by a flashing yellow light, but in every instance by yello alone, no light of any other colour being seen in conjunction with it.

This method of proceeding leads gradually to a second and very desirable step towards standardisation.

3. As regards indicating the route set up for a train, the solutions adopted vary to a great extent between the different railways and opinions are divided.

All railways however agree that in certain cases it is necessary to indicate the route to be taken, and it is then done in different ways (see Figs. 1, 2 and 3 for example), often by means of a series of conventional rulings combining the ideas of speed and direction in an arbitary manner. In the opinion of the author of this report, this complicates the reading of the signals unnecessarily, particularly on heavily worked lines and at the entrance to and outlet from the larger stations.

4. *What type of light signals do you use? With special red, yellow or red lenses, or the system making use of 2 or 3 light frames containing coloured glasses? Give the reasons for your choice.*
5. *What system do you use to make sure visibility is good at the foot of the signal? (« close up indication »).*
6. *What type of lamps do you use: with one or two filaments? Give the power and voltage of the lamps? What optical system is used: diameter of the outer lenses, horizontal and vertical dispersal?*

The reply to the questions set out above are given in tabular form below:

The following conclusions may be drawn from the above:

1. The use of two or more lenses is generally preferred to the arrangement in which an internal spectacle (2 or 3 position) is used, because the layout of the lights on the background plate does not allow a system using two or three light frames to be operated economically.

The only management among those consulted to use the « searchlight » system is that of the Netherlands Railways and it does so because this meets the requirements of the new system of signal indications which it has adopted. It is evident that no question of phantom indications can arise with this arrangement.

2. As regards close up visibility of a signal, the majority of lines use a deflector moulded in the body of the lens, or an independent and adjustable one.

One or two lines which do not use deflectors cause trains to stop at a distance of 20 m. (appr 22 yrds) in rear of the signal.

It is opportune to draw attention here to the great advantage of fixing the lights on a level with the driver's eye. This greatly facilitates picking up the lights, not only in fog but when a signal has to be observed at very close range.

3. As regards the diameter of the outer lenses of signals, the sizes 220 mm (8.661 inches) and 160 mm (6.299 inches) are both used.

The experience of the author has been that 160 mm (6.299 inches) diameter lenses allow of fixing at 0.60 m (1.968 feet) centre to centre, while the 220 mm (8.661 inches) lenses necessitate a spacing of 0.70 m (2.296 feet) to enable two or more lights on a signal background plate to be seen clearly at some distance. This means that the use of 160 mm (6.299 inches) lenses enables the size of the back grounds to be reduced, which is of advantage on an electrified line carrying heavy traffic.

4. The spread of the light beam varies from one railway to another, but the tendency appears to be towards reducing it so as to concentrate the beam as much

Railway	Types of light signal used		Close up visibility	Optic syste use
	Lens type	2 or 3 light frame type		
ALGERIA.	As on the S. N. C. F.	—	Deflecting unit in the outer lens itself or mounted in front of it.	2 lens wi loured gla tween the lens and
BELGIUM. *(S. N. C. B.)*	Lens type	—	Deflecting unit in the outer lens itself sending a small beam of light over an angle of 20° to 45° measured with respect to the vertical plane of the light.	— dc
DENMARK.	Lens type	The use of this type is being considered for signals in tunnels or where space is restricted and the lens type of signal cannot be installed.	Deflecting unit giving a partly horizontal and partly vertical dispersion.	Two lens of which loured.
FRANCE. *(S. N. C. F.)*	Lens type	—	Deflecting unit fixed inside the optical assembly and adjustable.	Two lens loured gl tween th lens and t
FRANCE. *(Paris Transport Board)*	Lens type	—	*City or Inner Metropolitan Lines.* The optical systems of these signals dc the light beam in a tunnel need only be o the lights being on a level with- and at a	
	Lens type	—	*Sceaux Line.* The lenses include a deflecting unit.	As or *S. N.*

Diameter outer lens	Dispersion		Bulbs		
	horizontal	vertical	Number of filaments	Voltage	Wattage
220 mm	4°	4°	1	7.2 V	15 W
160 mm	4°, 10° and 20° on curves.	1° 30′	1	7.2 V	15 W
200 mm	4° and 16°	—	2-one in reserve coming into action when first is burnt out.	30 V	15 W
220 mm the main lights, 160 mm the second light of the signal and the reduced d and redu- speed re- der signal.	4°, 10°, 20° on curves.	1° 30′	1	8 V	10 W for 4° horizontal dispersion, 15 W for 10° and 25 W for 20°.
ent any interesting characteristics, seeing that sity. No deflecting arrangement is used, nce from the driver's eye.			1 However two bulbs are used (one being in reserve) with automatic change-over in event of failure. In future units containing low voltage bulbs with 2 filaments, one 10 W and the other 5 W will be used.	130 V	25 W
60 mm	As on the *S. N. C. F.*			7.5 V	—

Railway	Types of light signal used		Close up visibility	Op sy u
	Lens type	2 or 3 light frame type		
LUXEMBURG.	Lens type	—	Deflecting mirror in the interior of the optical assembly above the bulb (for the red lights only).	Two le of them ed.
MOROCCO.	Lens type	—	No special device use.	—
NORWAY.	Lens type	—	No special device is used as trains are required to stop at least 20 m (app. 22 yrds) in front of the signal and the highest light is at 5.40 m (17.716 ft.) above rail level.	—
NETHERLANDS.	—	3 light frame with coloured glass.	Lens with deflecting prism (40° downwards formed in the « hot spot » position).	Fresne
SWITZERLAND. *(Federal and Emmental-Burgdorf-Thun line).*	Lens type	—	No deflecting device is used.	Two le colour
SWITSERLAND. *(Rhaetian Railway).*	Lens type	—	No deflecting device is used. Trains stop 20 m. in front of the signal.	—

iameter outer lens	Dispersion		Bulbs		
	horizontal	vertical	Number of filaments	Voltage	Wattage
60 mm	8°, 20° and 30° on curves	—	1	40 V	20 W
60 mm	12°, 24°	12°, 24°	1	5.7 V 7.5 V or 5 V	10 W 15 W
10 mm	8°, 30°	not specified.	1 or 2 according to circumstances; 1 filament in the caution (distant signals.); 2 filaments both burning, one more than the other, in home and ordinary block signals.	10 V	20 W 40 W
10 mm	2° in all directions About 15° and 30° on curves.	2°	1	11.3 V	13.3 W run at a voltage of 10 V actual service.
60 mm	8°, 20°, 30°	not specified.	1	40 V	20 W
60 mm	— do —	—	1	40 V	20 W

as possible, at all events on straight track.

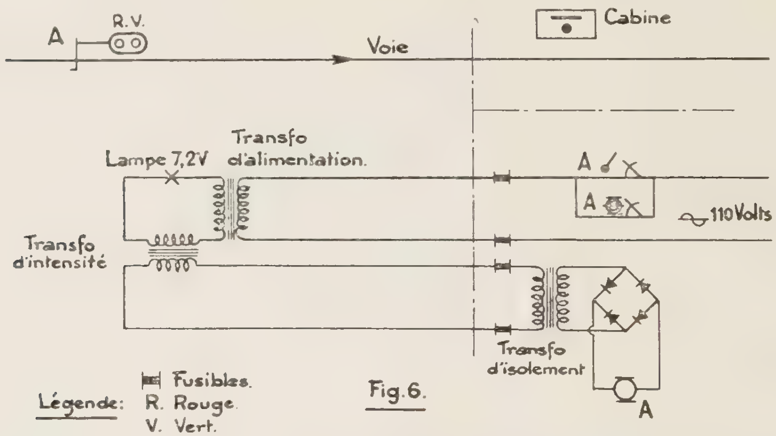
5. As regards the bulbs themselves, they vary very much both in type and voltage. It can be said, however, that the tendency is towards using a single filament bulb of moderate voltage, 7 to 8 volts, and of medium wattage, say 15.

7. *Are the signals worked directly from the signal boxes or are relays used at the foot of the signal? Do you repeat the signal lights in the signal box?*

8. *Do you check the lighting of the signal lights before allowing the up-*

ments applied on lines worked by 3 000 V.D.C. traction.

In the case of manually worked colour-light signals operated in conjunction with interlocked block, the aspect of each signal to « proceed » is dependent on receipt of a release from the next signal box down the line, and this can only be sent if the corresponding signal at that box has gone to danger behind the preceding train. Where the signalling is of the automatic block type, the signal box does not exercice any control.



Voie = Track. — Cabine = Seg. box. — Transfo d'alimentation = Feed transformer — Transfo d'intensité = Voltage transf. — Transfo d'isolement = Isolating transf. — Fusibles = Fuses — Rouge = Red. — Vert = Green.

per lights to be lighted? If so, what system do you make use of?

ALGERIA.

The lights are checked in the signal box by a relay connected to the feed circuit of the caution relay of the up-line signal.

BELGIUM. S. N. C. B.

When manual block working is in force all lights are checked in the signal box, the aspects of the signals being repeated continuously on the illuminated track diagram (see Fig. 6). It should be pointed out that we are referring to circuit arrange-

The « proceed » setting of a signal in an automatic block system, however, does not depend on the next down-line signal's going to danger behind the previous train; this change, from « stop » to « proceed » is operated solely by the action of the track relays. As regards the « caution » aspect of a signal, this of course is governed, in the up-line signal, by the aspect of the down-line signal (see Fig. 7).

It should be noted that in Figs. 6 and 7, it is assumed that no current is flowing in any circuit and all relays are de-energised.

DENMARK.

All lights are checked in the signal box by relays and repeater lamps. The checking of the lights of the up-line signal is effected by relays connected to the feed circuit to the lights of the down-line signal.

FRANCE. S. N. C. F.

Advantages is taken of the technical possibilities of light signals to simplify as far as possible the testing circuits.

Practically speaking this testing is confined to ascertaining whether a signal worked from a signal box has been set at danger as intended, without actually repeating the setting and the corresponding lights, and checking also in a similar

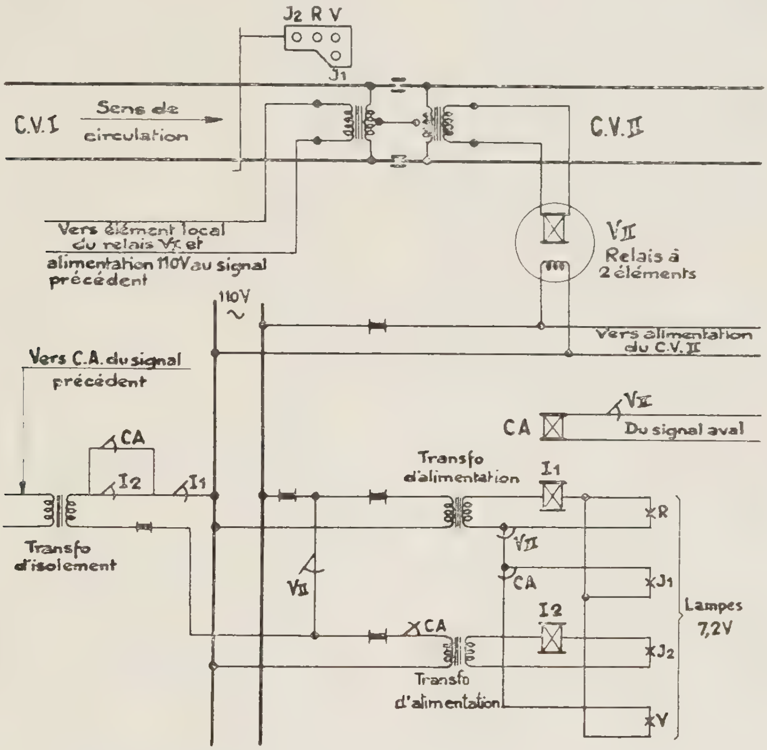


Fig. 7.

Légende : fusibles.
R : rouge.
V : vert.
J : jaune.
C.A. : contrôle avertissement.
I1, I2 : relais d'intensité.

Fusibles = Fuses. — Rouge = Red. — Vert = Green. — Jaune = Yellow. — Sens de circulation = Direction of traffic — C. V. = track circuit — Contrôle d'avertissement = proving in caution indication circuit — Vers élément local du relais VI et alimentation 110 V au signal précédent = To local element of relay VI and 110 V. feed to the preceding signal.— Vers C. A. du signal précédent = Caution proving signal to signal in the rear. — Vers alimentation du C. V. II = To feed to track circuit II. — Du signal aval = From the signal in advance. — Relais d'intensité = Voltage proving relay or relays. — Relais à deux éléments = Double element relay.

manner, the relative distant signal which preceeds the caution signal.

The aspects of automatic signals are no longer checked in any way. As a result of applying these principles, the lights are not checked, neither in the signal box with special testing apparatus, nor on the ground, by making the illumination of one signal dependent on that of another. On the other hand, in order to help the drivers, any signal the lights of which are out, is automatically shown on the preceding signal which is then set at « caution ».

FRANCE (Paris Transport Board).

All lights controlled from a signal box are checked in that box on an illuminated diagram by the use of relays, but this is not done in the case of automatic signals. The reply to question 8 is in the negative.

LUXEMBURG.

All signal lights are checked and repeated in the signal box, and the illumination of the lamps in a distant signal depends on a moving relay in the circuit of the stop signal ahead.

MOROCCO.

All signal lights are checked and repeated in the signal box. The reply to question 8 is in the negative.

NORWAY.

All signal lights are checked and repeated in the signal box without the use of relays. The lights are simply repeated directly. Automatic signals are not tested. The reply to question 8 is in the negative.

NETHERLANDS.

The « stop » and « proceed » aspects of signals are checked in the signal box. The reply to question 8 is in the negative.

SWITZERLAND.

All lights are repeated and therefore checked in the signal box. The illumination of a signal is checked, before the signal ahead may be illuminated, by placing the contacts of the moving relay of one signal in circuit with the signal ahead.

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From the above replies it may be concluded that no railway as yet places absolute confidence in the working of relays, but a clear tendency is noticeable to place growing confidence in those types of relays, which, in recent years, have attained a high degree of perfection in manufacture.

9. *Do you use flashing lights ? If so, for what reason and at what periodicity ?*

The Algerian, Belgian, French, Luxemburg, Moroccan and Swiss lines do not use flashing lights in their ordinary running signalling.

The Danish lines use them in distant signals, with 60 flashes per minute.

The Norwegian lines use them at 60 flashes per minute for the red lights protecting the entry to stations and movable bridges. In addition all yellow and green indications in the caution or distant signals are flashing.

The Netherlands Railways use a light flashing at 180 to the minute as a calling-on signal, to show that the track ahead is occupied, and one flashing at 75 to the minute for signals which are less than braking distance from the stop signal ahead.

The conclusion to be drawn from this is that in general, except in Norway and Denmark, flashing lights are not used in main running signals.

The Belgian Railways, however, intend to use lights flashing at 60 flashes per minute to control wrong direction movements on electrified lines (see Question 13 below) in order to prevent any confusion, at the entrance to a station where there are four tracks, with the signals controlling adjacent tracks.

10. *What precautions do you take to prevent the yellow light being confused with the red, and vice versa ?*

Of all the railways here concerned, only the Belgian and Swiss have adopted the following rule : a yellow light is never

seen by itself, but a red light is invariably shown singly. This means that in order to avoid confusion between a yellow and a red light, the various combinations of lights are so arranged that yellow is always combined with another yellow or with one or more green lights, while the red indicating « stop » is always seen by itself.

The other lines rely on the technical specifications which lay down certain characteristics for the yellow and red glasses. Thus the Netherlands adopt the rules of the Association of American Railroads, while France has developed colour filters giving clearly defined transmission curves.

For any given filter the transmission curve must lie between those for standard glasses of light and dark hue selected since 1936 as a result of many tests made under practical conditions of observation and visibility, and extending over a wide range of coloured glasses.

Since that date many other visual tests have been made to check the matter and no criticism of the selected standards has been made.

In conclusion, it may be pointed out that all railways have periodical eyesight tests for the drivers.

11. *Are you proposing to use light signals systematically on your electrified lines?*
12. *If the electrification is being carried out with overhead lines, will the signals be fastened to the catenary posts? Are there any drawbacks to this?*
13. *Do you use special signals for trains running in the wrong direction on one of two tracks in the case of an electrified line, to enable maintenance of the catenary lines to be carried out with one line temporarily out of service?*

All the managements consulted, except the S. N. C. F. and the Algerian and Moroccan lines, intend to adopt light signalling systematically as from the beginning of electrification.

However, in France, as automatic signalling is generally installed when electrification is introduced, light signalling follows more or less quickly.

It appears that it is the type of mechanical signal used that makes it possible in France (and has made it possible in Switzerland too notably) to retain for a certain length of time the mechanical type of signalling before adopting the colour light system.

All the railways are in agreement in not attaching the signals to the overhead traction catenary standards except in certain large and complicated stations when the signal gantries span several tracks and serve at times to support the overhead lines, special precautions being taken to insulate the signals from the traction voltage. However in the Netherlands signals of small size are at times attached to the catenary posts.

The reasons given by the various lines for adopting this practice are as follows:

1. Keeping the signal supports separate from the catenary parts makes it possible at all times to rearrange the spacing of the signals to meet the traffic working requirements.

2. When colour light signals attached to the catenary posts, the vibrations set up in the latter are liable to make the light beams vibrate also and to cause the bulb filaments to fail.

Of all the systems consulted which possess electrified double track, only the Norwegian uses wrong line signalling in order to allow the traction overhead line to be inspected and overhauled while the track concerned is out of use.

Belgium and Denmark propose to use in future on electrified lines wrong-direction signalling, because of the dense traffic which does not allow maintenance to be carried out during the intervals between trains.

France and Switzerland occasionally consider using a temporary wrong-direction signalling arrangement.

We would like to point out, however, that the S. N. C. F. is at present installing two direction signalling on each track of the two-track sections of the Paris-Dijon line now being electrified; but this development is mainly in order to increase the carrying capacity of the line which, for the greater part of its length, is four-track.

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CHAPTER II.

Centralized electrical operation of signal with interlocking levers or with the free push button system.

1. *What system do you prefer in the case of large installations; for what reason?*
2. *Do you prefer mechanical or electrical interlocking, where individual levers are used?*

Replies are as follows:

ALGERIA.	The Algerian Railways have only one electro-mechanical type signal-box with individual levers for the points and route levers for the signals.	Interlocking is of electro-mechanical type.
	Up to the present time all power signal boxes on the Belgian Railways have been of the electric type with individual operation of the points, routes and signals. There are a few boxes with route-signal levers. A panel with free push-buttons is under construction.	Interlocking is of electro-mechanical type, formed mainly of a locking box with locking bars and tappets and electro-mechanical locking devices.
DENMARK.	The Danish Railways have used up to the present individual operation of points and signals only, but a panel with free push-buttons is under construction.	Interlocking is electric.
FRANCE. (S. N. C. F.)	For many years past the French Railways have used, in the large stations, power signal boxes equipped with route-levers formed of a mechanically interlocked combiner containing the levers and electric locking devices for effecting approach and route locking, etc. These signal boxes give entire satisfaction both from the traffic — and the technical points of view. The S. N. C. F. has also now built some important signal boxes with free push-buttons, and several other very important ones are in course of construction.	Interlocking is of electro-mechanical type.
FRANCE. (Paris Transport Board.)	The route lever system and the free push-button arrangement are used on these lines. A panel on the latter system is in course of construction.	Interlocking is either electro-mechanical or electrical.

NORWAY.	On the Norwegian lines signal boxes with free push buttons are now preferred, and no other type is now being installed at either large or small stations.	Interlocking is electric.
NETHERLANDS.	On the Netherlands lines, there are power frames with individual point and signal levers, and left and right route-signal levers. It is intended in future to use on an extensive scale the NX relay system, and a large installation of this kind will shortly be in service.	Interlocking is of combined electric and electro-mechanical type.
SWITZERLAND.	On the various Swiss lines signal boxes with individual levers and route-signal levers have been installed. Two free push-button installations are under construction.	Interlocking is mechanical or electro-mechanical.

* * *

Those railways which continue to use mechanical interlocking consider that it constitutes a safeguard in that it facilitates the carrying out of work during such times as certain electrical safeguards are out of service. However, it would appear that the use of relays with connectors which are easily removable « en bloc », will facilitate the carrying out of work without having to use mechanical locking.

The advantages which the various railways see in the free push-button type signal boxes are as follows :

1. Signal boxes with non-locking levers or handles enable the controlling portions of the apparatus, and hence the corresponding panels or frames, to be reduced in size; this allows of the area of lines worked from a box to be increased, moreso as such signal boxes are well adapted to remote control and make the work of the signalman easier.

2. Signal boxes with non-locking levers lend themselves to the use of automatic cancelling of routes as well as to the recording of the controls that have been set up. These two arrangements bring a considerable simplification of the signalman's work, leaving him free to devote more attention to its mental side. Fewer signalmen are needed and thus the result is a flexible and simple handling of dense traffic.

3. It is not necessary for the relay room to be adjacent to the controlling desk or panel and this generally enables the size of the buildings required to be reduced.

4. Certain systems, such as those in Norway or those of the Paris Transport Board think that any change in installation is more readily effected than with individual levers using ordinary interlocking.

3. *Do you make use of selection in order to reduce the number of levers, e.g. one lever to work a signal controlling several routes?*

Certain Railways using, or which have used, individual lever type signal boxes, have replied in the affirmative, namely the Danish, Belgian and Swiss. These signal boxes are arranged with a single signal lever applying to a certain direction, the routes converging towards that direction being set up by preliminary selection levers.

4. *If push buttons are used, are these fitted on a geographical panel or a separate desk panel?*

The Belgian, Danish and French Railways use buttons mounted on a desk

separate from the illuminated diagram for the following reasons :

1) ease of mounting and of making any alteration to the desk;

2) ease of control of the traffic operations by the signalman, placed at sufficient distance from the diagram.

The Netherlands and Swiss Railways have decided to make an initial application of the arrangement in which the buttons are placed in their geographical positions on the diagram. Norway states that a trial installation of this method will be made there.

5. *Is it possible to make an automatic selection of the possible routes between two points, so that the first free route is chosen, according to an order laid down in advance? What system is used?*

On the Dutch lines, with the NX system, using « entrance » and « exit » buttons, it is stated to be possible to introduce automatic selection of the routes that can be set up between two points.

6. *Compare the technical advantages of the two systems.*

In addition to the advantages mentioned under 1 above, the S. N. C. F. remarks that this type of signal box enables electro-mechanical locks, so widely used in boxes with interlocked levers, to be dispensed with. (The lock is a somewhat delicate device calling for careful maintenance).

Besides this these signal boxes have traffic operating possibilities peculiar to their special type (automatic cancelling of routes, and recording of controls).

As regards the interlocked lever type of signal box with a capacity in the neighbourhood of 200 routes: this does offer certain facilities when a failure occurs.

Generally it can be concluded that with the free push-button panels, all locking of the operating mechanisms is effected by interrupting their control circuits and not by mechanical or electro-mechanical locking of the actuating parts.

The substitution of relays actuating the controlling circuits for electric locks or ordinary interlocking of the controlling levers is of real value and completely obviates the work of the fitter in the future.

7. *Is it not a fact that greater technical knowledge is necessary for the staff maintaining push button installations?*

8. *In view of the more complicated mechanism of push button systems, what steps have you taken to assure their proper maintenance?*

Only those railways which have had considerable experience with the system using free push-buttons are able to provide replies to these questions. These are the French and Norwegian Railways. We cannot do better than give the actual wording of the French reply.

The staff dealing with the maintenance of such installations with non-locking levers must of course have had some special training and have attained a certain level of technical ability. Its work is however made much easier on the one hand by the relatively simple circuit arrangements adopted, and on the other by certain special methods of assembling the equipment.

Thus complete assemblies or units are provided made up of several relays, operating together to perform a certain function, mounted together on a movable frame.

In this way the technical knowledge required by the maintenance staff is lessened and all that has to be done should any part get out of order is to remove the defective unit and replace it by another taken from stores.

It is to be noted that the replacement of a unit or a relay at a location is effected very rapidly, and, thanks to the automatic connecting devices provided with this kind of apparatus, there is no risk of a false connection being made in the wiring.

The reply received from the Norwegian Railways confirms the opinion expressed by the French Railways.

9. *Make the comparison of the two systems from the points of view of prime cost and maintenance.*

In this case also we give the actual reply received from the French Railway.

The example on which this comparison is based is that of an important S. N. C. F. station (Montereau : with 120 points, 78 colour-light signals and 338 routes, at present in the course of being equipped). The solution adopted is that of a central signal box of the all-relay type, with free levers.

Had it been decided to use interlocked levers, two signal boxes would have had to be provided.

A comparison shows that the costs of the free lever system, buildings included, are about 10 % less than in the case of the other arrangement. In addition the two signal boxes with interlocked levers would have required twice as many signalmen as the central all-relay signal box.

As regards the number of men engaged on maintenance, this can be regarded as being the same in either case. In fact the additional electric equipment which, in the free lever type of box, makes up for the economy afforded by the mechanical combiner or frame, does not appear to call for more maintenance than the combiner does, taking into account the particular arrangements adopted. At the most as stated above, the staff may require some special training, and this has not presented any difficulty.

The Norwegian Railways point out, on the other hand, that the free lever type signal boxes require a summary monthly inspection and a thorough overhaul annually.

10. *Does a break-down in a push button system have greater repercussions on the operating and traffic than a break-down in an interlocking system?*

Certain railways fear that break-downs in a free push-button system have greater repercussions on the operating and traffic than a break-down in the case of individual or route levers.

The French Railways, which have had considerable experience with the free push-button equipment, consider that boxes with non-locking levers do definitely give rise to more serious and complicated problems for the traffic department in case of break-down than does the interlocked lever type of signal box. However it is thought that this small disadvantage is largely compensated by the many advantages of the free push-button type of box.

11. *What are the advantages and drawbacks of electrical control and electro-pneumatic control of the points?*

No railway among those consulted uses the electro-pneumatic system. We cannot do better, we think, than give the reasons advanced by the S. N. C. F. with which we are in entire agreement.

1. Electro-pneumatic operation requires the same electric controlling and checking, or detecting circuits, as does electric operation. It requires in addition equipment for producing and distributing the compressed air, which, in addition to cost, calls for careful and skilled maintenance.

2. The working efficiency of electrical control is much greater than that of a compressed air system.

3. The use of an electric motor allows of points being reversed sufficiently rapidly (in 3 seconds at the most in the case of points on running lines and 0.4 seconds in the case of marshalling yard points) and the movement is less violent than it is with the electro-pneumatic system.

4. Generally speaking electric operation is more flexible and allows the direction of movement to be instantly reversed should the controlling lever or handle be returned to its original position, which is difficult to arrange with the electro-pneumatic system.

12. *What steps have you taken to avoid having to use temporary signals when the points have been run through in the wrong direction and damaged?*

All the railways adopt positive and constant checking of the points by means of the circuits controlling the clearing of the signals reading over the routes in which the points in question are included.

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CHAPTER III.

Distance control and operation of points and signals by means of relays

The following is the list of questions relating to this matter :

1. *To what extent have you made use of the system :*
   a) *on single track lines;*
   b) *on double or multiple track lines?*
2. *What signalling system did it replace :*
   a) *on single track lines;*
   b) *on double or multiple track lines?*
3. *For what reason has it been used ?*
4. *Do you intend to extend it?*
5. *What are the principal advantages?*
6. *What arrangements have been made to ensure the efficient maintenance of the equipment?*
7. *Do you have any difficulty in getting suitable staff for such maintenance work?*

Only the Belgian, Danish, French, Netherlands and Norwegian Railways have replied. The others are not contemplating the use of remote control installations.

The particulars received are given below :

BELGIUM. (S. N. C. B.)

1. This system has not yet been applied on the lines of the S. N. C. B.

2-3. It is not possible to reply to these questions as no practical application of the system is at present in existence.

4. The S. N. C. B. is at present installing a system of this kind at a junction to be controlled by a signal box 3.5 km (2.1748 miles) distant.

It proposes to extend it to cover three junctions situated at several kilometres from an interchange station so as to concentrate the whole of the working in one all-relay signal box.

5. The principal advantages of concentrated control appear to be :

a) greater flexibility in the working of the traffic, due to the unified control which this system makes possible;

b) in the reduction in staff which it makes possible. This brings about a real saving only when the capital cost of construction is not prohibitive. This condition can only be realised if the operating and moving circuits for the remote control require only a small number of wires.

6. Lack of experience prevents a reply being given to this question.

7. In view of the technical standard of our present maintenance staff we do not anticipate any difficulty in finding suitable persons for the work of maintenance.

DENMARK.

1. The system is being installed on several single track lines.

2. Remote control usually replaces mechanical double-wire equipment.

3. The advantages claimed for it are as follows :

a) the controlling apparatus occupies but little space and can be installed at the point most favourable to its operation;

b) economy is sometimes realised due to fewer signal boxes having to be built;

c) the relays used can be standardised and may thus be mass-produced;

d) electrical interlocking is preferred to mechanical interlocking.

4. The Danish Railways are going to extend the system to other lines.

5. See 3.

6. Having regard to the fact that the relays are of the plug-in type and thus easily replaceable without any risk of error,

no difficulty in maintaining the apparatus is anticipated. In addition the repair and overhaul of these relays is done in special workshops.

7. There are no difficulties under this heading.

FRANCE. (S. N. C. F.)

1. The S. N. C. F. has made use of remote control :

a) for controlling isolated installations, at a distance, from some pre-determined point (junctions, entrances to reception lines). The first instance of this was at Onville Junction, installed in 1934;

b) for concentrating at one central point (central signal box) the controlling and checking of all the points and signals of a given station, using remote control for the areas situated at a distance from the signal box.

- an installation is in course of construction at Montereau station with 338 routes (two junctions located some few kilometres distant will at the same time, be brought under the control of the signal box);
- another installation at Juvisy, with 720 routes, is being designed;

c) for setting up centralised traffic control.

The first installation was put into service in 1933 between Houilles and Sartrouville, about 3 km (1.8641 miles) long (covering 3 tracks, one being arranged for traffic in either direction) operated by remote control by the traffic controller at Paris St. Lazare, 15 km (9.3206 miles) distant :

- two double track sections (with both tracks arranged for two-way working) are at present under construction on the Paris-Lyon main line; these two sections are the following :
- first section : Dijon-Blaisy Bas, 27 km (16.7770 miles);
- second section : Les Laumes-St. Florentin, 84 km (52.1952 miles).

These sections will be remote controlled by the traffic controller at Dijon. The installation between Houilles and Sartrouville is based on the individual lever arrangement, but the installation being built on the Paris-Lyon line will be the first centrally controlled section using route-levers.

N. B. — With the exception of the type known as P. S. A. (postes semi-autonomes = semi-independent signal boxes) in use at Onville, which uses a step-by-step (pas-à-pas) mechanism, all the others have all-relay equipment.

2. The S. N. C. F. considers that remote control does not constitute a signalling system in itself but a technical basis on which to carry out an installation, particularly suited to solving certain operating problems in certain given circumstances.

3. The reasons which have guided the S. N. C. F. in the choice of the applications considered in the reply to question 1 are based essentially on the following points :

a) the concentration of controls enables appreciable economies in staff to be realised, while, at the same time affording greater operating facilities;

b) in particular, when a whole section of line is involved, such concentration allows the actual traffic control operation on that section to be effected by the controller himself, thereby eliminating any loss of time in transmitting orders and any delay in executing them;

c) thanks to the tracks being made available for trains in either direction it is possible to make the maximum use of one or more of them, which avoids the necessity of having to lay down additional tracks.

4. In view of the satisfactory results obtained the S. N. C. F. intends to extend the system as far as circumstances will permit.

It has already elaborated a formula « safety, regularity and speed » which is

eminently applicable to the problem to hand. This formula will be applied more especially in the case of the installations at Montereau and Juvisy. (Detailed particulars of the system will be found in an article by Mr. WALTER, Chief of the Signals, Telecommunications and Overhead Lines Department, S. N. C. F. entitled « A new type of route-lever signal box » in the April 1948 issue of the *Bulletin of the International Union of Railways.*)

5. See 3 and 4.

6. A remote control installation comprises essentially the following :

— the equipment for transmitting over a distance the operating and detecting or checking impulses;

— the signal box (or boxes) out along the line.

The maintenance of the transmitting apparatus is made comparatively easy by the general use of removable units with automatic connectors.

7. Taking into account the arrangements applied, and mentioned in the preceding reply, there are no particular difficulties in finding and training the staff required to maintain such an installation, as is proved by the experience gained by the S.N.C.F. with the working of the Houilles-Sartrouville C. T. C. centralized installation of 1933.

NORWAY.

1. A few examples of remote control have been installed, notably at junctions situated at a distance from stations, using a 4-core cable (centralized traffic control system).

2. Some old mechanical installations have been replaced by remote control equipment.

3. The reasons for installing remote control are, in order of importance :

a) economy in operating staff;

b) lower maintenance costs;

c) less risk of error in working.

4. It is intended to extend the system in those cases where the advantages mentioned above are appreciably felt

5. See 3.

6. Proper qualified staff is appointed to carry out maintenance.

7. No difficulty has been experienced under this heading.

NETHERLANDS.

1. The system has only been applied so far to a few isolated sets of points.

2-3. —

4. It is expected to use the C. T. C. system on a single line to avoid doubling.

5. Anticipated advantages are :

a) economy in operating staff;

b) better regulation of the train service with increase in the density of the traffic on a line.

6-7. —

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CHAPTER IV.

The automatic block with track circuits using a permanent or coded flow of current.

1. *Do you make use of track circuits worked by permanent or coded current for the automatic block signals? What do you consider the maximum length advisable for the track circuits in each case? What shunt is obtained by the train with track circuits of 500, 1 000, 1 500 and 2 000 m (546, 1 093, 1 640 and 2 187 yards) with :*

   a) *direct current;*

   b) *alternating current without inductive connections;*

   c) *alternating current with inductive connections;*

   d) *coded current.*

The S. N. C. F. is the only railway concerned which reports using coded track circuits.

They mention :

— some 30 track circuits controlling automatic signals and fed by direct

current on the Petite Ceinture, Paris (maximum length of track circuit, 1 500 m [1 640 yards]);

— some twenty A.C. track circuits controlling similar signals on the Grande Ceinture, Paris (maximum length of track circuit, 1 500 m [1 640 yards]);

— about ten isolated point locking track circuits using pulsating direct current (maximum length, 500 m [546.8 yards]).

Most railway systems consider that the maximum length of track circuit fed with permanent current is about 2 000 m (2 187 yards).

The replies received indicate that the shunts obtained vary considerably from one railway system to another and sometimes reach fairly high figures.

In view of the diversity of the replies, we will give the minimum values required under the various circumstances by the S. N. C. F.

Character of feed current	Length of sections			
	500 m 546 yrds	1 000 m 1093 yrds	1 500 m 1640 yrds	2 000 m 2187 yrds
Direct current	0.5	0.3	0.2	0.15
Alternating current (without impedance bonds)	0.5	—	—	—
Alternating current (with impedance bonds)	0.15	0.15	0.15	0.15
Pulsating direct current	1	0.75	0.5	—
Pulsating alternating current	0.5	0.5	0.5	—

The values are in ohms.

We may add however that certain Railways adopt higher values for some of the above figures.

2. *What are the advantages of coded current track circuits?*

According to the opinion of those railways which have this matter under consideration, the advantages of this system are chiefly as follows :

a) for sections of equal length the shunt is greater than with track circuits of other types;

b) similarly for a given shunt value the length of the sections obtainable with coded current circuits is greater than with any other system;

c) extraneous or leakage currents are less likely to influence the working;

d) it is easier to consider using cab signalling than with any other arrangement.

3. *What economies do you expect to obtain to make good the extra cost of coded current track circuits?*

It would appear from all the replies received that practically speaking no economy is realized by using track circuits. Only the technical advantages set out above are obtained, to compensate in some measure for the greater cost of the coded current equipment.

4. *What confidence have you in the two systems from the point of view of safety and regularity?*

Opinion is not quite definite on this point. We cannot do better than reproduce the actual wording of the conclusion, with which we are in agreement, reached by the S. N. C. F.

It appears in every case that, from the safety point of view, coded current signalling is slightly superior to signalling which uses permanent current in the track

circuit, but that, on the other hand, its working appears to be slightly less reliable in action.

5. *Are the track circuits supplied with current from the railway supply, through a substation, or from batteries?*

All lines using alternating current track circuits use power from the « grid » transformed as required in substations.

In the case of direct current track circuits power is also taken from the « grid » and rectified by a booster battery or a floating battery with trickle-charging. On some lines, here and there, battery track circuits are found.

6. *What is the average distance between the signals?*

The replies received give the following figures:

Denmark : 1 200 to 1 600 m (1 312 yards to 1 749 yards);

Belgium : 800 to 1 210 m (875 yards to 1 323 yards);

France (S. N. C. F.) : 2 000 m (2 187 yards) maximum;

Paris (Transport Board) : 170 m (186 yards) city lines — 350 m (383 yards) sceaux line;

Norway : 1 000 to 3 000 m (1 094 yards to 3 281 yards);

Netherlands : 1 500 m (1 640 yards);

Switzerland : 750 m (820 yards).

The great differences between the replies given above show that the distance between signals depends above all on two factors:

1) the spacing called for by the traffic department, as a function of the frequency and speed of the trains;

2) the braking distance required on the lines under consideration.

It is certain that in the case of lines carrying fast trains which have to be equipped with automatic signalling the signal spacing constitutes one of the essential factors in striking the balance in favour of an increase in speed, with due regard to the fact that any alterations made later would prove to be very costly.

There is thus every reason to select a distance between signals which will permit high speeds. Obviously it is quite another matter on Metropolitan and suburban lines where speed is limited by other circumstances (closeness of the stopping points, presence of tunnels, curves, etc.).

7. *What frequencies are used and what precautions do you take to prevent the coded current of a track circuit affecting that of the adjoining track circuit should the insulated rail joint get broken?*

The frequencies used on the S. N. C. F. lines are 75 and 180 pulsations per minute.

In order to prevent coded current from one track circuit influencing the neighbouring one in the case of failure of an insulated joint, it is usual to reverse the polarity of adjacent circuits. In addition polarised code-following relays are used.

8. *What type of insulated rail joint do you use?*

Most of the railways use insulated joints with either packings of fibre or cotton cloth impregnated with bakelite.

Certain others use laminated joints made of bakelized wood, while on some lines metal joints insulated with bakelized fibre are being tried.

Some lines are still using wooden joints, or supported joints.

It is certain that in view of the necessity of increasing both speed and comfort the tendency towards using longer and longer rails will grow. The problem of the insulated joint will then become very complicated and most probably new solutions will have to be sought.

9. *What is the average number of breakdowns of all kinds per signal and per year for your automatic block installations ?*

Those Railways which keep records on this point, report an average of 0.5 to 0.6 failures per signal per year, which is remarkable result to be obtained at the present time and with the equipment in question.

The Paris Transport Board gives however an altogether exceptional figure of 0.05 failures per signal per year, of which half is due to the components of the track circuit, each signal is operated about 120 000 times a year.

It is as well to add here that of the total number of cases on the various lines, the number of failures prejudicial to safety is practically negligeable.

10. *How does the signalman in charge of a junction on a line fitted with the automatic block know the direction a train approaching one of the two branches of the junction has to take ?*

On most lines where this case arises, the signalman is advised of the class of train approaching by telephone, either by the preceding station or by the dispatcher or traffic controller.

On the lines operated by the Paris Transport Board all trains carry a clearly distinguished identification number in front and in rear. In addition the signalmen are given a working graphic timetable, and are advised by telephone when necessary of any change made in the running of the trains. In this way, as soon as one train passes they can set up the route for the next.

11. *When the automatic block is used, drivers are allowed to run past certain signals at danger but not others. How is the driver to be made to know when he is allowed to run past a signal at danger ?*

On certain railways, such as the Danish, Norwegian and Swiss, a train may only pass an automatic signal at danger after receipt of a telephone authorisation from the nearest signal box or station. On the Belgian and French lines two distinct types of stop signal are used :

a) an absolute stop signal, which may only be passed on authority received from the nearest station or signal box;

b) a permissive (automatic) stop signal which the driver is authorised to pass on his own account and proceed to the next signal though be must be prepared to stop short within range of vision.

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INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

15th. SESSION (ROME, 1950).

QUESTION XIII.

Modernisation of the maintenance methods of the permanent way on the light railways.

REPORT

(Austria, Belgium and Colony, Bulgaria, Denmark, Spain, Finland, France and Overseas Territories, Greece, Hungary, Italy, Luxemburg, Norway, Netherlands and Colonies, Poland, Portugal and Colonies, Rumania, Sweden, Switzerland, Syria, Czechoslovakia, Turkey and Jugoslavia),

by L. Ripert,

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FOREWORD.

The object of Question 13 on the agenda of the 15th Session of the International Railway Congress Association is the study of « The modernisation of maintenance methods for the permanent way on secondary lines ».

This study covers both lines operated by secondary-railway companies and the secondary lines of main-line railways, which are so classified on account of the smaller amount of traffic they carry and the lower speed of the trains running on them.

The information brought together in the present report was collected from railway Administrations in other than English-speaking countries.

Out of the 81 Administrations consulted :

16 replied that the questionnaire did not concern them, or that they were unable to supply any useful information;

31 sent in positive replies.

The question has been divided into three parts :

I — Staff : modernisation of the organisation of the gangs;

II — Modernisation of the maintenance methods properly speaking;

III — Modernisation of the equipment.

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I. STAFF. MODERNISATION OF THE ORGANISATION OF THE GANGS.

Composition of the gangs.

1. *Small gangs and gangs working over long distances.*

On most railways, the staff dealing with the maintenance of the permanent way is divided up into small gangs of 3 to 6 men, sometimes more, in charge of a section usually varying from 6 to 14 km (3.7 to 8.7 miles). These small gangs are sometimes reinforced when special work has to be carried out.

On the lines of the 12 Administrations enumerated below, this distribution has been modified, in order to obtain better output, by forming larger gangs responsible for longer sections :

— The Belgian National Light Railways state that, when they took over the lines now constituting their system, small gangs which had the advantage of being able to work simultaneously had to be formed. Now that the condition of the lines has been improved, a better organisation is possible, and the present tendency is to group the gangs over long sections.

— The Lower Congo to Katanga Railway is now carrying out a vast mechanisation programme for its gangs (native labour); the gangs used for maintenance by inspection and distributed over approximately 60 km (37 miles) long sections will be progressively decreased, and a large gang for systematic maintenance operations set up for each section.

— The French National Railways Company (S. N. C. F.) has set up, on its lines with small traffic, known as « co-ordinates », long-distance gangs which make it possible to have sufficient labour with a low man power per kilometre. This condition is obtained either by dividing up the lines in star formation, or by adding one or two branches on co-ordinated lines to the section for which the large gang of a main-line junction is responsible.

— The French Departmental Railways tend to form large gangs on some important systems, their output being definitely better than that of the small gangs.

— The French General Light Railways Company for more than twenty years has generalised the use of long-distance gangs, usually consisting of 9 or 10 men responsible for an average of 30 km (18.6 miles). Small gangs are the exception, and are used either on certain short lines, or at the ends of certain lines near the area for which a long-distance gang is responsible, to save them having to travel excessive distances.

— The Light Railways of Northern France have set up on one of their lines 64 km (39.8 miles) long, having a total of 110 km (68.3 miles) of track, a gang consisting of 30 men. These consist mostly of specialists assisted by welders and men capable of adjusting the track and equipment. The special work, covered by the annual programme for renewing the track or laying sleepers, is contracted out, the contractor's gang, which consists of about ten men, being under the permanent control of an inspector.

— The North Eastern Light Railways Company (France) has divided up its staff into gangs responsible for 35 to 45 km (21.7 to 28 miles) long sections on the standard-gauge lines.

— The Tunisian Light Railways Company has turned all its maintenance gangs into long-distance gangs consisting of a comparatively large number of men, except in the case of some important centres where average or small gangs are still retained so that staff is always available in case of unforeseen circumstances. Out of the 33 sections into which the system is divided, 26 are long-distance, covering 95.6 % of the running tracks. The length of the sections varies from 110 to 35 km (68.3 to 21.7 miles); the average length is 61 km (37.9 miles).

— The Portuguese Railways Company has set up a few long-distance gangs, consisting on the average of 18 men.

— The Rhaetian Railway (Switzerland) has divided its men into 17 gangs, the average number in each being 13 men, and the average length of the sections 23 km (14.3 miles).

— The Viège-Zermatt and Furka-Oberalp Railway (Switzerland) has set up gangs of 12 to 15 men responsible for sections of 20 to 22 km (12.4 to 13.7 miles).

— The Emmental-Burgdorf-Thun Railway (Switzerland) considers that the use of large gangs is more economical than that of small gangs, and has grouped its men into large gangs responsible for extended sections.

— In the case of the Paris Metropolitan Railway, operated by the «Regie Autonome des Transports Parisiens » (R. A. T. P.), the

problem of maintaining the track is a very special one, owing to the structure of its lines and special operating characteristics which are peculiar to certain urban railways in large capital cities; in particular, while traffic is running, owing to its density, special precautions have to be taken to assure adequate safety precautions on lines in tunnels where the lighting is poor. On the other hand, the maintenance of the railway has not yet reached normal conditions, especially on certain sections of line only recently opened to traffic. The recruiting of permanent staff for the permanent-way maintenance has so far been limited to the numbers required to supervise the permanent maintenance operations, for urgent work, and to superintend the work of the contractors' gangs. Most of the other work is contracted out; the amount of work contracted out (from 7 gangs of 25 men to 2 gangs) varies, however, according to the discontinuity, extent and ageing of the system. The provisional solutions adopted for the distribution of the staff in charge of the track maintenance consequently differ considerably from those on other railways.

2. The table hereafter gives, for the different railways, data concerning :

— the lengths of lines operated, distinguishing between :

those with full passenger and goods services (76.5 % of the total length, 55 % being standard or wide gauge, and 45 % narrow gauge);

those with only goods services (23.1 % of the total length, nearly all standard-gauge lines);

and those with only passenger services, which represent 0.4 % of the total length.

— the maximum axle-loads:

of locomotives, varying from 11 to 20 Engl. tons for standard-gauge lines (exceptionally 5 tons);

of locomotives varying from 6 to 16 tons for narrow-gauge lines;

of wagons varying from 10 to 18 tons for standard-gauge lines and of wagons varying from 5 to 16 tons for narrow gauge lines (exceptionally 3.5 tons);

— the maximum train speeds (excluding railcars) varying from 25 to 90 km (15.5 to 55.9 miles) an hour for standard-gauge lines and 25 to 60 km (15.5 to 37.3 miles) an hour for narrow-gauge lines;

— the distribution of the mileages and average numbers of men in the small gangs, and for the long-distance gangs, which vary within the following limits :

a) for small gangs, from 3 to 9 men, and even 13 men, responsible for 6 to 16 km (3.7 to 9.9 miles), the labour density varying from 0.25 to 1.76 man per km (0.4 to 2.82 men per mile);

b) for long-distance gangs, of from 6 to 15 men and exceptionally 20 men and even 30 men, responsible for 30 to 80 km (18.6 to 49.7 miles) and even 110 km (68.3 miles), the density varying from 0.10 to 0.51 men per km (0.16 to 0.82 man per mile).

3. *Determination of the labour per kilometre.*

The main factors determining this ratio, which varies considerably, as has been seen, from the information received from most of the Administrations, can be classified as follows :

Track and installations.

— Characteristics of formation; profile and layout : in level country or mountainous, sections particularly exposed to landslides, flooding, etc. (the latter especially mentioned by the Swiss lines);

— Gauge (standard or wide, narrow, sometimes mixed), with 3 or 4 files of rail;

— Characteristics of the track (weight of the rails, kind of sleepers and ballast) and state of wear of the track equipment;

Distribut

RAILWAY SYSTEMS S. G. = Standard gauge N. G. = Narrow gauge		Length of lines operated		Maximum axle-loads (tons)		Maximu hourl train sp
		Km	Miles	Loco-motives	Wagons	Km
AUSTRIA :						
Federal Railways :						
Passenger and goods services	S. G.	1 821	1 132	11 to 16	11 to 16	25 to 60
	N. G.	507	315	8.5 to 16	8.5 to 16	25 to 40
		2 328	1 447			
BELGIUM :						
Belgian National Light Railways :						
Passenger and goods	N. G.	4 233	2 630	9 and 7	8	60
Lower Congo to Katanga :						
Passenger and goods	N. G.	1 700 approx.	1 056 approx.	15	15	—
DENMARK :						
State Railways :						
Passenger and goods	S. G.	1020	634	16.5	16	70
FINLAND :						
State Railways :						
Passenger and goods	S. G.	4 159	2 584	11 to 14	13 to 17	65 to 85
FRANCE :						
National Railways Company (S. N. C. F.) (co-ordinated lines) :						
Goods only	S. G.	10 900 approx.	6 773 approx.	17	16	40
Departmental Railways :						
Passenger and goods	S. G.	70	43	18	16	80
	N. G.	724	445	9.1	7.5	55
Goods only	S. G.	55	34	20	16	50
		849	522			
General Light Railways Company						
Passenger and goods	S. G.	873	542	11 to 18	16	75
	N. G.	794	493	9 to 11	8	55
Goods only	S. G.	307	191	11 to 18	16	40
	N. G.	283	176	8.5 to 11	8	25
		2257	1 402			
Northern Light Railways :						
Passenger and goods	N. G.	67	41.6	10	—	35
Régie Autonome des Transports Parisiens :						
Passenger and goods	S. G.	20	12.4	17	16	80
Passenger only	S. G.	166	103.1	12	—	50
		186	115.5			

ge and the labour.

Small gangs					Long-distance gangs				
Average number of men S	Length of section L		Labour density S/L		Average number of men S	Length of section L		Labour density S/L	
	Km	Miles	per Km	per Miles		Km	Miles	per Km	per Miles
t. months : 7	14	8.7	0.5	0.80	—	—	—	—	—
n. months : 12	14	8.7	0.9	1.45	—	—	-	—	—
5	20	12.4	0.25	0.40	15 to 20	60 to 80	37.3 to 49.7	0.25	0.40
—	—	—	—	—	—	—	—	—	—
2 and 3	9	5.6	0.22 to 0.33	0.35 to 0.53	—	—		—	—
4 to 6	8 to 10	5.0 to 6.2	0.55	0.88	—	—	—	–	—
—	—	—	—	—	Main lines			0.18	0.29
—	—	—	—	—	Sidings			0.275	0.44
3	17	10.6	0.17	0.27	—	—	-	—	—
3	6 to 8	3.7 to 5	0.40	0.64	6	63	39.1	0.10	0.16
—	—	—	—	—	8	55	34.2	0.14	0.225
—	—	—	—	—	9	30	18.6	0.30	0.48
—	—	—	—	—	9	30	18.6	0.30	0.48
3	8 to 12	5.0 to 7.5	0.25	0.40	6	33	20.5	0.18	0.29
3	12	7.5	0.25	0.40	6	33	20.5	0.18	0.29
—	—	—	-	—	20	67	41.6	0.30	0.48
—	—	—	—	-	—	--	—	—	-
—	—	—	—	—	—	-	—	—	—

RAILWAY SYSTEMS S. G. = Standard gauge N. G. = Narrow gauge		Length of lines operated		Maximum axle-loads (tons)		Maximum hourly train speed	
		Km	Miles	Loco-motives	Wagons	Km	Mi
North-Eastern Secondary Railways :							
Passenger and goods	S. G.	343	213.1	11 to 17	15	70	43
	N. G.	64	39.8	6.5	7	40	24
Goods	S. G.	92	57.2	11 to 15	10 to 15	25 to 45	15.5 t
	N. G.	9	5.6	6	7	20	12
		508	315.7				
General Local Railways Company :							
Passenger and goods	N. G.	103	64.0	—	—	35 to 45	21.7 t
Goods only	S. G.	10	6.2	—	—	35	21
	N. G.	22	13.7	—	—	35	21
		135	83.9				
Gafsa Railway Company :							
Passenger and goods	N. G.	455	282.7	10	10	55	34
Tunisian Railways Company :							
Passenger and goods	S. G.	470	292.0	22.2	15.5	80	49
	N. G.	1.177	731.4	12	11.4	75	46
Goods only	N. G.	10	3.7	12	11.4	50	31
		1.657	735.1				
Western and Equatorial African Railways :							
Passenger and goods	N. G.	5 200	3 231	11 to 15.7	7 to 9.5	25 to 40 50	15.5 t 31
Franco-Ethopian Railways :							
Passenger and goods	N. G.	780	484.7	10.8 and 8.5	10.8 and 8.5	55	34
GREECE :							
Greek State Railways :							
Passenger and goods	S. G.	1 232	765.5	15.9	5	90	55
ITALY :							
Mediterranean Railways :							
Passenger and goods	N. G.	738	458.6	11	9	45	2
North of Milan Railways :							
Passenger and goods	S. G.	237	147.3	17	16	60 to 80	37.3 t
South-Eastern Railways :							
Passenger and goods	S. G.	473	293.9	14	14	90 and 65	55.9 4
Venitian Secondary Railways Company :							
Passenger and goods	S. G.	456	283.3	15	15	85	5
	N. G.	32	19.9	10	5	40	2
		488	303.2				

age and the labour *(Continued)*.

Small gangs					Long-distance gangs				
Average number of men S	Length of section L		Labour density S/L		Average number of men S	Length of section L		Labour density S/L	
	Km	Miles	per Km	per Miles		Km	Miles	per Km	per Miles
3 to 6	6 to 16	3.7 to 9.9	0.40	0.64	15	35 to 45	21.7 to 28	0.37	0.59
3 to 4	7 to 20	4.35 to 12.4	0.28	0.55	—	—	—	—	—
2 to 5	7 to 20	4.35 to 12.4	0.30	0.48	—	—	—	—	—
2	9	5.6	0.22	0.35	—	—	—	—	—
3 to 5	12.5 to 17.5	7.8 to 10.9	0.24 to 0.28	0.38 to 0.55	—	—	—	—	—
3	10	6.2	0.30	0.48	—	—	—	—	—
4	22	13.7	0.18	0.28	—	—	—	—	—
6	9	5.6	0.66	1.06	—	—	—	—	—
18.4	10.4	6.5	1.76	2.82	31.4	61	37.9	0.51	0.82
—	—	—	—	—	—	—	—	—	—
7	10	6.2	0.70	1.1	—	—	—	—	—
Forests 7	6 to 7	3.7 to 4.35	1	1.6	—	—	—	—	—
Savanna 10	10	6.2	1	1.6	—	—	—	—	—
13	13	8.1	1	1.6	—	—	—	—	—
9	10	6.2	0.90	1.44	—	—	—	—	—
6 to 9	7 to 10	4.35 to 6.2	0.90	1.44	—	—	—	—	—
8 to 9	12 to 16	7.5 to 9.9	0.65	1.04	—	—	—	—	—
5.77	7	4.35	0.82	1.31	—	—	—	—	—
5	7.5	4.7	0.65	1.04	—	—	—	—	—
5	7.5	4.7	0.65	1.04	—	—	—	—	—

Distribution of

RAILWAY SYSTEMS S. G. = Standard gauge N. G. = Narrow gauge	Length of lines operated		Maximum axle-loads (tons)		Maximum hourly train speed	
	Km	Miles	Locomotives	Wagons	Km	Mile
Sardinia Light Railways : Passenger and goods . . . . N. G.	617	383.4	8.5	4.5	35	21.
LUXEMBOURG : *Luxembourg Railways* : Passenger and goods . . . . N. G.	113	70.2	9	9	40	24.
NORWAY : *State Railways* : Passenger and goods . . . . S. G.	4 224	2 624.5	18	18	90	55.
N. G.	115	71.5	—	—	—	—
	4 339	2 696				
NETHERLANDS : *Netherlands Railways* : Passenger and goods . . . . S. G.	407	252.9	15 to 20	16	50 to 75	31. to 4
Goods only . . . . S. G.	328	203.8	do	do	15 to 60	9.3 to
	735	456.7				
PORTUGAL : *Portuguese Railways Company* : Passenger and goods . . . . S. G.	309	192.0	19	17.75	80	49.
N. G.	606	376.6	11	8.37	60	37.
	1 005	568.6				
Mozambique Colonial Railways : Passenger and goods . . . . N. G.	380	236	19.8	18.6	90	55.
SWEDEN : *State Railways* : Passenger and goods . . . . S. G.	2 685	1 668	17	18	80	49.
N. G.	2 143	1 332	8.9	11	60	37.
	4 828	3 000				
SWITZERLAND : *Rhaetian Railway* : Passenger and goods . . . . N. G.	393	244.2	12	11.5	65	40
Viège-Zermatt Furka Oberalp Railway : Passenger and goods . . . . N. G.	144	89.5	11.7	8	45	2
Emmental-Burgdorf-Thun Railway : Passenger and goods . . . . N. G.	170	105.6	18	25	80	49

age and the labour *(Continued).*

Small gangs					Long-distance gangs				
Average number of men S	Length of section L		Labour density S/L		Average number of men S	Length of section L		Labour density S/L	
	Km	Miles	per Km	per Miles		Km	Miles	per Km	per Miles
4	6	3.7	0.66	1.06	—	—	—	—	—
6	15	9.3	0.40	0.64	—	—	—	—	—
—	—	—	1.35	2.17	—	—	—	—	—
4 to 5	8	5.0	0.50 to 0.62	0.80 to 1.0	—	—	—	—	—
do	do	do	0.33	0.53	—	—	—	—	—
7	10	—	0.7	1.1	18	—	—	—	—
5	10	—	0.5	0.8	—	—	—	—	—
14	10	—	1.4	2.25	—	—	—	—	—
4	10	—	0.40	0.64	—	—	—	—	—
4	10	—	0.40	0.64	—	—	—	—	—
—	—	—	—	—	13	23	—	0.57	0.92
—	—	—	—	—	12 to 15	20 to 22	—	0.61 to 0.68	0.98 to 1.09
15	12	—	1.25	2.0	23	20	—	1.15	1.85

— Importance of the lines and installations in stations and of bridges, tunnels;
— Amount of accessory work falling upon the gangs;
— Age and state of maintenance of the lines.

Traffic.

— Kind of service worked : passenger and goods, or only goods;
— Importance of the loads, frequency and speed of the trains. Many railways consider this factor to be of prime importance.

Climate, and physical strength of the men (factors reported, in particular, by certain overseas railways).

The Netherlands Railways decide the number of men in each gang according to the « Driessen » formula which takes into account :

a) the length in kilometres of the running track;

b) the length in kilometres of the track in sidings;

c) the number of level crossings;

d) the number of points and crossings in the running track;

e) the number of points and crossings in the sidings;

f) other factors (fences, number of locomotives in the shed, etc.);

g) the train frequency;

h) the condition of the subsoil (1).

The French National Railways Company has fixed at 0.18 man the labour density for running track; at 0.18 man per km (0.29 per mile) and 0.275 man per km (0.44 man per mile) for sidings on the « co-ordinated » lines, i. e. those on which only a few goods trains are run at speeds equal to or less than 40 km (25 miles) an hour; the figure is raised to 0.28 man per km (0.45 man per mile) on running track whereon light railcars are run.

The French Departmental Railways stress the cost of maintenance; they have reduced the staff to the minimum compatible with safety and use of the equipment, whilst making an effort to improve the latter (in particular, by the general use of impregnated sleepers).

The Tunisian Railways determine each year the number of men required for maintenance, by means of a calender programme according to the lengths of line to be, reconditioned and the state of the track.

Determination of the length of the sections with long-distance gangs.

Taking the various factors enumerated above into consideration, two others also affect the length of the sections :

1) the maximum number of men who can be put under the command of a ganger;

2) the time taken to get from the gang's headquarters to the outer limits of the section.

As regards the first point, it appears that a gang of 15 to 20 men is usually the maximum and that one of 10 men better suits the ability to command of the average ganger.

As regards the second point, it appears advisable that the journey should not exceed half an hour, when, as on the French Railways, the men's working conditions lay down that one hour to get to and from work is the maximum time not included in the working time. In the case of a gang conveyed at an average speed of 30 km (18.6 miles) an hour, the corresponding distance is 15 km (9.3 miles). It can consequently be admitted that if headquarters are sited about the middle of the section, the length of the section should be about 30 km (18.6 miles). This length can be appreciably increased in the special case in which the headquarters are sited at a junction of several lines, the section consequently including several branches about 15 km (9.3 miles) long.

On the other hand, certain Administrations allow considerably longer sections : the Belgian Light Railways Company, from 60 to 80 km (37.3 to 49.7 miles); the

(1) Appendix I gives details of the « Driessen » formula and a an example of its application.

French Departmental Railways, from 55 to 65 km (34.2 to 40.4 miles); the Tunisian Railways, from 35 to 110 km (21.7 to 68.4 miles) (the latter in the case of large and well supervised gangs).

4. *Typical composition of a gang.*

a) The small gangs generally include a ganger, sometimes an assistant ganger, and 2 to 5 platelayers, i. e. 3 to 6 men. They are sometimes reduced to two men. On the other hand, on certain railways the gangs consist of larger numbers : the gangs of the Greek Railways consist of a ganger or assistant ganger, a look-out and 7 or 8 workmen; those of the Franco-Ethiopian Railways, a ganger, an assistant ganger and 8 to 12 labourers, all natives; those of the Tunisian Railways may exceed 18 men.

b) The long-distance gangs are generally made up as follows :

— a ganger;

— one (or sometimes several) assistant-gangers;

— 7 to 10 and sometimes up to 18 platelayers, one of them being a truck driver, and one a spare driver.

On some railways where the sections are very long, there are considerably more men in each gang. For example, on the Tunisian Railways, the standard composition of a gang (in which the number of men permanently employed varies between 50 and 18) is as follows :

1 ganger;

2 or 3 assistant-gangers;

1 lorry or truck driver;

one third of platelayers;

two thirds of assistant platelayers.

On this Company the tendency is to decrease the number of men in the gangs, the permanent composition of which is too high at present, to between 12 and 25 according to the importance of the gang, seasonal labour being used to complete the numbers as required, as described further on.

The duty of the ganger in every case is to supervise the section, for which he is responsible as regards the safe running of the trains, and the way the maintenance work in which he takes part is done.

However, on the Franco-Ethiopian Railways, the ganger has very little initiative to take; he merely causes the work ordered by the District Officer, to be carried out, and acts as timekeeper for the men.

The Portuguese Railways recognize that the output of a ganger is only one quarter of that required of a platelayer.

The French Light Railways Company define the duties of the ganger as follows; he must :

have a thorough knowledge of the condition of all parts of his section, and therefore himself carry out periodical inspections of the track;

know the general overhaul programme and, if there is one, the reduced overhaul programme, drawn up for the year and for the month in question, and do everything possible to see that it is carried out;

discover any defective points requiring partial repairs and decide of the whole or only part of the gang is required to carry out the necessary work;

direct the carrying out of the seasonal work and the various jobs devolving upon the maintenance service;

supervise and police the track and its immediate surroundings and advise his superiors of any abnormal facts observed.

On the Tunisian Railways, where as stated above, there are many men in the gangs, the ganger has a checker who marks out in advance, the work to be done and checks it afterwards; the section is divided up into sub-sections working simultaneously each one having its own duties.

Often there is not the same number of men in a gang throughout the year. It is, as a matter of fact, rational to increase the number during the summer when work can progress, and reduce it to the minimum in winter. The Swedish Railways only retain, during the winter, track-watchmen, who rarely have assistants. Certain

Railways increase the number of men in the gangs in summer, either systematically (Rhaetian Railways, Viège-Zermatt, Emmental-Burgdorf-Thun), or only when special work has to be carried out (track renewals, modifications of the layout, construction of branch lines), or to make good a prolonged reduction in the size of the gang on account of exceptional work, or illness.

The Tunisian Railways had, and will have for some years to come, a surplus of platelayers, so that they are obliged to have the seasonal work carried out by permanent employees, but they consider that, in the future, only the staff required for work of a permanent character should be permanently employed, and that seasonal work (weeding, heavy earthwork, ballasting, and repairing accidental damage in particular) should be carried out by means of temporary staff.

It is often difficult, however, to recruit temporary labour of the required quality in sufficient numbers; consequently certain Railways, who have tried to make this their general practice, have had to give it up.

Where the staff lives.

5. On more than half the railways, the men are scattered along their section. But the general tendency is to try and group them as much as possible near a central station; in the case of long-distance gangs with a collective means of transport at their disposal, this is one of the first conditions to be fulfilled if satisfactory results are to be obtained. The chief obstacle to it is the lack of accommodation.

The Rhaetian Railways have concentrated a certain number of men in stations where there are locomotive sheds, in order to get snow cleared away, and because assistance has to be sent out from these stations if anything upsets the working.

On the French West and Equatorial African Railways and the Franco-Ethiopian Railways, the staff is grouped, at the headquarters of each gang, which is either a station or a camp on the open line, sited as far as possible in the middle of the section for which the gang is responsible. On the Tunisian and the Gafsa Railways, the men are also always grouped at the headquarters of the gang.

6. The percentage of men accommodated in buildings belonging to the railway, and whose wives act as crossing keepers or station masters, is very variable. On the Italian Railways (Mediterranean, South-Eastern and Venitian Railways) all the men are accommodated in rail permanent waymen's houses. On lines belonging to several Administrations, the percentage of men housed varies from 6 % to 90 %. On the French National Railways Company's lines carrying only goods traffic, this percentage is about 50 % but, as a rule, the wives of the platelayers are not permanent employees of the railway, as the work of looking after the level crossings is done under contract. Finally, on nearly half the railways, none of the men are housed in this way, or the percentage is very low.

Methods of conveying the staff to work.

7. *Individual transport.*

On some railways (Franco-Ethiopian, French Western and Equatorial African, Gafsa, Greek State), the staff walks from the place where it lives to the place of work, tools and equipment being pushed on a handtruck. But the men belonging to small gangs generally have bicycles. Members of large gangs also use them to get either to the central station where collective means of transport await them, or directly to work.

On certain lines, in particular of the French National Railways Company, special cycle paths have been provided alongside the permanent way, but usually the men have to go by the nearby roads.

Certain Administrations pay an allowance to men using their own bicycles (France : National Railways Company, Departmental Railways, General Light Railways Company, North-Eastern Light Railways, Tunisian Railways; Luxembourg Railways, Netherlands Railways). These allowances are based on the mileage or the

number of days the bicyles are used, or else are monthly allowances.

Finally, the Swedish State Railways mention, as means of individual transport, hand trucks, the use of which entitles the owner to certain allowances, and the Danish State Railways, railbicycles.

8. *Collective transport.*

The large gangs generally have either a motor truck which can pull a two-wheeled trailer, or else a lorry. The table hereafter gives the leading characteristics of the vehicles used.

In addition, electric motor brake-vans and a small lorry are used on an electrified line of the Northern Light Railways (France).

Hand-operated trucks are used on the Austrian Federal Railways to carry small gangs (they can negociate gradients of 20 mm [1 in. 50]) with the help of an auxiliary speed gear), and on the Finnish State Railways (capacity 10 men, speed 30 km = 18.6 miles an hour).

Finally, ordinary trains are used, particularly on lines where the stations are near each other (for example on the Rhaetian Railways where the distance between a station and the place of work rarely exceeds 1.5 km [0.9 mile]). Sometimes the men and their equipment can be taken right to their place of work by these trains, if the latter can stop at that place without inconvenience from the operating point of view.

9. *Reasons for selecting a given method of transport.*

The advantages and drawbacks of the three principal methods of transporting the staff belonging to large gangs are summed up below :

a) *Individual bicyles.* — Advantages : flexibility, since there is no interference with railway traffic; economy (although if allowances are made to the staff for the use of their bicyles, collective methods of transport may prove cheaper).

Chief drawbacks : fatigue for the men before beginning work, and sometimes loss of time, especially if they have a long distance to cover, or in hilly country.

b) *Trucks.* — Advantages :

— Staff, tools and equipment are rapidly carried from headquarters to the site of work;

— They can be used to remove the earth from cuttings being maintained, or when the formation is damaged;

— The state of the track and its immediate surroundings can be examined by the ganger, and safety inspections can be carried out in bad weather;

— The men are little fatigued;

— The trucks can be used as a shelter during bad weather, if they are stabled near the place of work.

Drawbacks :

— Difficulties inherent in all railway traffic (safety regulations), whence loss of time while waiting for right of way, at crossings, etc...;

— Inconvenience of taking up space on the line when the traffic is very heavy, or, on the other hand, on lines where there is very little traffic, difficulty of getting a right of way during the long periods when the stations are unstaffed as regards the men responsible for the traffic safety;

— Expenses for fuel and lubricant consumption, maintenance and depreciation ;

— Consumption attributable to running light, when the truck, after setting down the men at place of work, returns to a station;

— Inconvenience and loss of time in case of a breakdown (reserve trucks are necessary to replace trucks out of action);

c) *Lorries.* — Advantages over trucks :

— Independent of traffic on the line, as explained above, which sometimes means a faster journey;

Leading characterist

	Trucks and t			
	Engine power HP	Transport capacity: Number of men	Transport capacity: Tonnage hauled in practice (tons)	Weig of the veh (ton
AUSTRIA :				
Federal Railways	12 to 60	—	—	1 tc
BELGIUM :				
National Light Railways Company	—	—	—	—
FRANCE :				
National Railways Company	40	18 + 20 (trailer)	—	[illegible]
Departmental Railways	—	15	—	—
General Light Railways Company	25 45	13 15	5 10	2. 3
North-Eastern Secondary Railways	18 12	20 6	— —	4 1.
Tunisian Railways Company	45 70 110	2.5 (*) 2.2 2.2	8 25 50	5 7 7.
NETHERLANDS :				
Netherlands Railways	12.5	12	—	1
PORTUGAL :				
Portuguese Railways Company	16	16 to 18	—	2
SWEDEN :				
State Railways	10	6	—	0

(*) Useful load in tons.

cks and lorries.

rly running speed		Lorries					
		Engine power	Carrying capacity		Dead weight	Hourly running speed	
m	Miles	HP	Number of men	Useful load (tons)	(tons)	Km	Miles
o 60	18.6 to 37.3	—	—	—	—	—	—
—	—	—	—	3 to 5	—	50	31.1
0	24.8	15	20	4	—	40	24.8
—	—	—	—	—	—	—	—
0	18.6	—	—	—	—	—	—
. 50	Max. 31.1	—	—	—	—	—	—
o 50	24.8 to 31.1	—	—	—	—	—	—
0	18.6	—	—	—	—	—	—
0	31.1	17	—	3	2.3	70	43.5
0	37.2	15	—	4	2.5	60	37.2
0	24.8	—	—	—	—	—	—
5	28	67.5	12	—	2.4	58 to 80	36 to 49.7
3	20.5	—	—	—	—	—	—
5	28	—	—	—	—	—	—

— Lower cost price, less fuel used, easier to get spare parts.

Drawbacks compared with rail trucks :

— Need for roads alongside the railway;

— Usual impossiblity to get directly to the place of work, so that the tools and equipment have to be carried a fairly long way from the nearest siding or level crossing. This drawback does not exist when there is a road alongside the railway.

— Road journeys are useless for examining the state of the railway track.

Light Railways Company allow the trucks to be taken off the rails near the place of work. The latter Company considers this an appreciable advantage as regards the time saved; consequently its 85 trucks are all relatively light (2.2 to 3 tons) so that they can be rapidly removed from the line by 2 men by means of a special turntable (fig. 1).

A field telephone connected up with the telephone line by means of thin poles makes it possible to communicate with the neighbouring stations or a junction station for safety reasons (fig. 2).

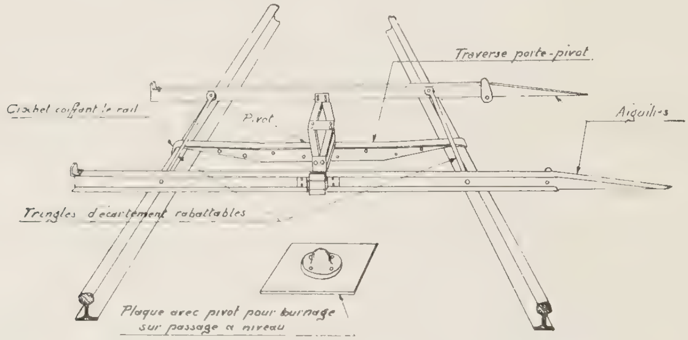

Fig. 1. — Revolving frame for turning and derailing the truck used by the French General Light Railways Company.

Explanation of French terms :

Aiguilles = switches. — Crochet coiffant le rail = Hook gripping the rail. — Plaque avec pivot pour tournage sur passage à niveau = Plate with pivot, for turning on level crossings. — Traverse porte-pivot = Pivot bearing crossbar. — Tringles d'écartement rabattables. = Folding gauge ties.

10. *Traffic regulations for trucks.*

From the point of view of the traffic, whether they are being used to carry the gangs or for inspection runs, the trucks are generally treated like service trains; on certain railways they run according to a service timetable; generally they have no fixed timetables, but ask for a right of way by telephone.

On most Railways they are not taken off the rails at any point on the run, but garaged in the stations nearest to the site of the works. On the other hand, the Swedish State Railways and the French General

11. *Measures intended to encourage the staff to increase the output.*

Premiums are paid to the staff by several Administrations. Amongst those who replied :

— 20 do not pay any output premiums;

— 2 (French Departmental Railways and Viège-Zermatt Railway) only pay premiums for special or urgent work (clearing away snow, landslides, etc.).

— 1 Administration (Austrian Federal Railways) is collecting information on which to base piece-work rates according to the difference between the

number of hours allocated in advance for a given piece of work and the actual hours of work; this extra-wages will be uniformly divided up amongst the men forming the gang, but the bonus of any man cannot exceed 25 to 30 % of the basic wage in any case;

good worker » corresponding to a maximum of about 15 % of the usual wage, the result of which has been to increase output by about 15 %.

— The French National Railways Company have instituted a system of premiums the coefficient of which, based not only on output, but also on the quality of the work,

Fig. 2. — Turning and derailing a truck off the rails (General Light Railways Company.)

— 1 Administration (Rhaetian Railway) which considers that a premium system is not necessary to stimulate the innate working enthusiasm of its staff, exceptionally pays a given premium for certain work entrusted to a gang.

The 8 following Administrations regularly pay output premiums :

The Finnish State Railways make use of the premium system to the greatest possible extent, which has resulted in increasing output by about 30 %; in addition they pay an extra allowance known as « for a

gives the relative value of the gang; this coefficient varies between 0.70 and 1.40. According to the case, the premium represents between 5 and 10 % of the employee's wage. It is difficult to estimate the effect of the premium upon the output, owing to the very different kinds of work carried out by the gangs.

— The French General Light Railways Company has instituted premiums based on the following principle : each gang receives a mark which takes into account the output of work (especially overhaul), its quality, the behaviour of the track and

installations, and, on the other hand, the ratio of the actual strength of the gang to the number of men as laid down, for a given period. The gangs are classed according to their marks, and each of them is allocated a premium based on its mark. Each man receives an individual premium equal to the premium for his gang multiplied by an individual coefficient depending upon his own mark and a grade coefficient as determined for each grade. Owing to its collective and yet individual character, this premium gives the gang a common interest that ought to appreciably improve the output, especially when, thanks to this improvement, the premium rate can be increased.

— The Tunisian Railways Company introduced, as from January 1st 1948, output premiums determined in the following way : each gang receives a primary mark which is the total of 5 marks given for : the output, the quality of the work, the behaviour of the gang, the difficulty of the route, and safety. The number of units qualifying for a premium are calculated according to the grade of the different members of the gang, which vary from 1 to 1.75 according to the wages scale. The final section mark is the product of 3 marks : the primary gang mark, the district mark, and the section mark. The resulting premiums vary from 0.8 to 1.2 of the average premium determined each month according to the total allocation based on the economies obtained. This premium is collective, all the men of the same gang receiving the same premium, unless an individual reduction is made, which is very rare, in the case of men whose work is definitely unsatisfactory. Since these premiums were introduced, there has been 20 to 30 % increased output, but as the work was reorganised at the same time, it is hard to decide how much of this is due to the premium system.

— The French Northern Light Railways pay an output premium of approximately 8 to 10 % according to the behaviour of the employee, and an additional premium for all work carried out under very special conditions or occasionally requiring more extensive specialisation.

— The North-Eastern Secondary Railways (France) have instituted output premiums for replacing sleepers and for laying stops on curves. A fixed premium is allocated for a minimum of 5 or 6 sleepers replaced per man per day, according to whether the ballast is broken stone or sand; this is increased by a premium proportional to the number of sleepers replaced over and above this minimum amount. The premiums are individual in the case of the small gangs, and collective in the case of the long-distance gangs. The average percentage is from 5 to 8 % of the employee's wage. The resulting improvement in output is from 25 to 30 %.

— The Portuguese Railways Company pay an annual premium per section, allocated to the ganger whose methodical revision has been classed as the best in his section.

— The Swedish State Railways for several years have paid collective output premiums representing 10 to 15 % of the usual wage. Although their influence on output has not been actually calculated, it has been found that they lead to savings.

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II. MODERNISATION OF MAINTENANCE METHODS PROPERLY SO CALLED.

What modern maintenance methods consist of.

12. The old maintenance methods consisting of isolated operations carried out here and there according to need, have generally been given up. The drawbacks they entailed (loss of time, going to and coming from the site, irregularity of the track in layout and profile as the result of successive and badly co-ordinated operations, difficult control of the staff) led to new methods being preferred, which give better technical results and a higher output. However, certain Administrations have retained the traditional method, at least on some of their secondary lines. Two of them state that this is due to the defective state of the lines and the small equipment brought into play on lines with little traffic, but they

consider that they are only a makeshift, and that it would be desirable to do away with them as the general condition of the permanent way improves.

There is a certain diversity in the up-to-date methods used by the different railways. They can, however, be classified into the following categories :

a) The *general overhaul* made as continuous as possible, covering a definite mileage every year, with *partial repairs* to certain defective points, is the method used by 16 Administrations. This method consists in carrying out, in a given order, all the operations required to remedy and defects in the section of line in question, replacing all the necessary materials, so that the section will remain in sufficiently good repair until the next overhaul.

However, the Franco-Ethiopian Railway Company now carries out a « methodical overhaul » which is a discontinuous general overhaul, made necessary by the age of the track, with partial repairs, especially during the rainy season; later on, when the permanent way has been renewed, they will apply the general-overhaul method mentioned above.

b) The method comprising the *integral overhaul*, which concerns the materials, the level, and the layout of a given part of the section every year, and also the limited overhaul of another part, concerned above all with the level and the tightening up of the fastenings, with *part repairs* at certain point if necessary, is applied by 7 Administrations.

Amongst these, the Tunisian Railways consider that any rigid cycle of integral overhaul leads to additional cost, and they completely overhaul every year the worst sections of the line only, which show the following defects :

— more than 10 cm (4 inches) play has to be made good;
— more than 30 % of the sleepers have to be replaced;
— a drop in level of more than 10 cm (4 inches) has to be corrected;
— dirty and caked ballast;
— curves to be re-aligned.

c) Other methods which differ slightly from the above are applied by a few Administrations :

1. complete renewal of the sleepers every year on a given part of the section, including the replacement of all the sleepers and any defective small equipment and, if necessary, defective rails, with ordinary maintenance of the rest of the section (2 Administrations);
2. limited overhaul of a part of the section and partial repairs to the remainder (1 Administration);
3. maintenance according to annual programmes based on the actual state of the installations, carried out as necessary, taking care to avoid dispersion of the work, reduce the amount of travelling that has to be done, facilitate the service, and improve the output (1 Administration).

The following table classifies the Administrations, in a general way, according to the maintenance methods adopted, and also gives the durations of the general or integral overhaul cycles.

13. The length of the cycle for the general or integral overhaul adopted by the different Railways varies from 1 to 6 years.

Overhaul of the whole system is carried out every year by 2 Administrations : The Finnish State Railways (owing to special soil and climatic conditions), and the Franco-Ethiopian Railway (owing to the age of the permanent way).

The Netherlands Railways and Portuguese Railways have a two-year cycle, as well as the R. A. T. P. in the case of the elevated lines of the Paris-Metro.

A 3-year cycle has been adopted by the Greek State Railways. The French General Light Railways Company also applies a 3-year cycle in the case of lines ballasted with sand where relatively light permanent way equipment is used as compared with the loads carried.

The most general cycles are from 4 to 6 years. In the case of the Tunisian Railways, they differ according to whether the lines are laid on wood (4 to 6 years) or metal

Maintenance methods applied by the different Administrations.

Maintenance methods	Administrations	Length of cycle (years)
a) General overhaul of a fraction of the section and partial overhaul of the remainder.	AUSTRIA : *Federal Railways*	variable
	BELGIUM : *Lower-Congo-Katanga*	now under considerat.
	FINLAND : *State Railways*	1
	FRANCE : *Departmental Railways Company* . . . (certain lines)	4 to 6
	General Light Railways Company . . .	3 to 6
	R. A. T. P. (Paris Metro).	2 to 5
	North Eastern Light Railways Company	6
	Western and Equatorial African Railways	4 to 6
	Franco-Ethiopian Railways	1
	GREECE : *State Railways*.	2
	ITALY : *Mediterranean Railways*.	6
	North of Milan Railway	5
	Venetian Secondary Railways Company . .	5
	PORTUGAL : *Portuguese Railways Company* . . .	2
	Mozambique Colonial Railways . .	4
	SWITZERLAND : *Emmental-Burgdorf Railway* . .	4 to 6
b) Integral overhaul of a fraction of the section, limited overhaul of another fraction, and part repairs to the remainder	FRANCE : *General Light Railways Company* (certain lines).	5
	North-Eastern Secondary Railways (certain lines)	6
	Tunisian Railways Company (wood sleepers)	4 to 8
	do- (metal sleepers).	6 to 10

Maintenance methods applied by the different Administrations *(continued)*.

Maintenance methods	Administrations	Length of cycle (years)
b) (suite)	LUXEMBURG : *Luxemburg Railways*	8
	NETHERLANDS : *Netherlands Railways*	2
	SWITZERLAND : *Rhaetian Railway*	1 to 10
	Viège-Zermatt Railways . . .	5 to 15
c_1) Complete renewal of sleepers on a section and maintenance of the remainder.	BELGIUM : *National Light Railways Company* (electrified lines).	
	FRANCE : *Northern Light Railways*	
c_2) Limited overhaul of a fraction of the section and part repairs to the remainder.	BELGIUM : *National Light Railways Company* (secondary lines)	
	FRANCE : *General Local Railways Company*. . . .	
c_3) Maintenance according to an annual programme based on the actual state of the installat.	FRANCE : *National Railways Company* (lines with limited traffic known as « co-ordinated »	
	DENMARK : *State Railways*	
d) Maintenance as required.	FRANCE : *Departmental Railways Company* (certain lines)	
	North-Eastern Secondary Railways Company (certain lines)	
	Gafsa Railway (Tunis)	
	SWEDEN : *State Railways*	
	ITALY : *Sardinia Railways*	

sleepers (6 to 10 years). In the case of the underground lines of the R. A. T. P. Paris, the cycle is 3, 4 or 5 years, according to the kind of ballast, layout traffic, density, and age of the different sections.

The cycle is rarely longer than 6 years. However, it is 8 years on the Luxemburg Railway, and the Viège-Zermatt Railway report that their cycle varies from 5 to 15 years.

14. When there is only a limited overhaul, the mileage so treated every year varies a great deal, according to requirements; approximate figures have been given by some railways :

Australian Federal Railways : 10 %;

North Eastern Secondary Railways (France) : 10 %;

Luxemburg Railways : about 40 %;

Tunisian Railways : from 25 to 100 %;

Rhaetian Railway : 22 % on an average.

15. On some Administrations the method differs, according to the lines, and to the amount of traffic carried: whereas the integral-overhaul method is applied on lines carrying traffic of a certain importance, a limited overhaul or even maintenance as required is applied on lines with little traffic or only goods services. On other Railways, the general method is the same, but the maintenance tolerances differ.

Finally, station sidings are often treated differently from the running track (for example tamping instead of shovel packing) and at longer intervals (for example 6, 8 or 10 years).

16. *Enumeration of the operations included in the general overhaul.*

These operations are enumerated below, according to the practice of most of the Railways :

1. Weeding the ballast, if necessary, and clearing away the ballast from the sleepers.

2. Overhaul of the track equipment and fastenings :

a) Replacing damaged rails and sleepers; strengthening split sleepers;

b) Overhauling the joints (regulating the joint gaps, taking down, inspection and maintaining the joints, replacing worn fishplates or inserting packing pieces);

c) Checking the spacing and squareness of the sleepers;

d) Overhauling the fastenings (replacing and tightening up coachscrews, rebevelling the sleepers, correcting the gauge and the cant of the rails).

3. Revising the level, and lining up the track :

a) First lining up of the track;

b) Lifting up the track and rectifying the level both longitudinal and transversal (tamping or shovelpacking the sleepers).

4. Re-ballasting, final lining up, squaring off the sides of the bed and formation.

5. Cleaning out the ditches and drains for carrying away the water.

6. Tightening up the coachscrews and fishbolts; checking for deformations, if necessary, a few weeks later.

The order in which these various operations are carried out is about the same on all the railways, except as regards the replacement of damaged sleepers, which takes place :

— either immediately after the ballast is removed (as indicated above), which makes it possible to tighten up the fastenings continuously on both the new and old sleepers;

— or when the fastenings are overhauled, which makes it easier to see if certain sleepers need replacing before the operation in question;

— or sometimes when the track is being lifted, a large amount of such work having to be done, so that less ballast has to be removed, especially when the extent of this lifting is sufficient to avoid upsetting the bed of the sleepers;

— or, on the contrary, as the initial operation previous to the overhaul, this being necessary when the level is restored by shovel packing, so that the new sleepers bear on a sufficiently compacted bed.

In this latter case, in particular, it is recommended to replace isolated sleepers by « gravillonnage » (fine-gravel packing), which consists in sweeping any ballast out of the sleeper bed after withdrawing the sleeper, and when the new sleeper has been put in place, packing the empty space between it and the bed with fine gravel.

On the R. A. T. P. (Paris Metro) the following operations have to be added to those enumerated above : collecting grease, spreading lime if needs be to disinfect the underground permanent way, planing the rails if necessary, maintenance of the third rail and its equipment, and screening the ballast in the stations.

17. *Enumeration of the operations entailed in restricted overhaul.*

A limited overhaul consists essentially of :

1) correcting the general level discontinuously (in particular taking up low joints and loose sleepers);

2) tightening up the fastenings, generally continuously.

In general, replacing or consolidating the equipment does not form part of a limited overhaul. Sometimes, however, sleepers which have reached their limit of wear and would not last until the next integral overhaul are replaced (the Tunisian Railways limit the number of sleepers replaced under these conditions to 150 per km [240 per mile] at the most).

Certain Railways, on which integral overhaul is not in use, also include correcting the track gauge in the limited overhaul. On the other hand, other Railways do not include therein the correction of the alignment and superelevation on curves on lines run over at low speeds.

18. *Summary enumeration of the operations included in certain other methods.*

1. Complete renewal of sleepers and defective small equipment;

Lining up and levelling the track, and reballasting;

Overhauling the fishplates.

2. Maintenance carried out according to an annual programme depending upon the condition of the installations, without following any periodic cycle :

Maintenance of the track equipment chiefly consisting in replacing sleepers;

Maintenance of ballast limited to drainage and running off water;

Tightening up the fastenings, if there is any danger of gauge widening;

Revision of the track level, mainly affecting the joints.

Details of the application of different maintenance methods.

A. *Maintenance of the rails and fishplates.*

19. Three Administrations indicate that they do not make use of any special methods to *make good any wear in the fishplates* or the fishing surfaces on the rails.

One of them (North of Milan) removes rails and fishplates from the running tracks to station sidings, when they are too worn for further use on running tracks with their high traffic requirements. The other Administrations use one of the methods enumerated below, to make good any wear in the fishplates and fishing surfaces of the rails :

1) Simply replacing the fishplates by new ones, if possible thicker than the old fishplates, to make up for any wear in the rails;

2) Heightening the fishplates taken out :

— either by restamping which will heighten fishplates 1.5 to 4 mm (1/16 to 5/32 inch) (9 Administrations);

— or building up by electric welding (2 Administrations);

— or by bending them cold, this being done on the line by means of special apparatus (Fig. 3) (Swedish State Railways).

The Netherlands Railways make good any wear by using either bent or cold-pressed fishplates, according to the amount of wear, and at the present time, fishplates sucessively pressed and bent.

3) Inserting packing pieces along the top

fishing surface (7 Administrations). The most usual type is the SHIM, the thickness of which decreases from the end of the rail.

Several Railways who re-stamp their fishplates in their shops, prefer this method to the use of packing pieces.

20. As regards *welding the joints*, 23 Administrations do so, either as general practice, or experimentally.

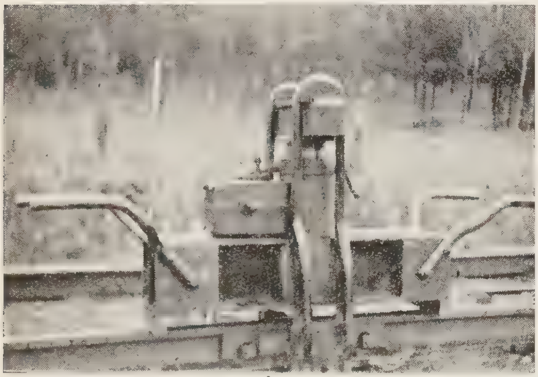


Fig. 3. Equipment for cold-bending the rails (Swedish state Railways.)

The following methods are used, either exclusively or jointly :

1) Thermit welding (13 Administrations);
2) Electric welding (8 Administrations);
3) Oxyacetilene welding (2 Administrations.

Two Administrations state that all their lines are laid with long rails obtained by welding, viz. the Emmental-Burgdorf-Thun Railway (4/5ths of the joints by electric welding, now using the **SECHERON** method, 1/5th by thermit welding, the standard rail length being 36 m [118 ft 1 1/4 in.]), and the Northern Light Railways (France), either by the thermit or the electric process, the latter gradually giving way to the former method, expansion being assured by means of special joints. The length of the rails obtained, as given by several Railways varies from 16 to 36 m (17.5 to 39.3 yds.), and up to 60 m (65.6 yds.) on the Tunisian Railways.

Joints are especially welded on metal bridges, in roads (at level crossings or when the line runs along the road), and in underground track, as well as for joining up rails of different cross-section.

21. Building up the frogs of crossings by arc welding or oxyacetylene welding is done by 15 Administrations; but it would seem that with most of them, this is not the current practice. Certain Railways are building up the ends of worn rails, as an experiment.

B. *Maintenance of the sleepers and fastenings.*

a) *Wood-sleepers.* — The lines belonging to 21 out of the 36 Administrations are laid on wood sleepers, either completely of for the most part.

22. The fastenings are tightened up by methods which make it possible to re-use the old, worn holes, or by re-drilling the sleepers.

1) The following methods are used in order to re-use the old hole rather than having to re-drill the sleeper, according to the information supplied by 5 Administrations :

— Using a coachscrew of larger diameter than the old one;
— Using metal spiral linings suiting the thread of the coachscrew (A. S. linings), and wooden wedges (V wedges), or plastic products (a method tested but which does not appear to have been adopted);
— Stopping up the hole by means of a rectangular peg, and then drilling the peg, is a method which has proved satisfactory and is recommended by the Railways using it.

2) When the old hole is not re-used, it is plugged up and another hole drilled (method used by 13 Administrations).

The Venetian Railways mention that they use sleepers 2.60 m (8 ft 6 3/8 in.) long instead of 2.40 m (7ft 10 1/2 in.) to enable them to be displaced longitudinally when they have to be re-drilled. Re-drilling is frequently adopted when the sleepers are not

impregnated, as they generally have to be scrapped on account of the wood rotting, rather than the lack of a sound area suitable for re-drilling. This method is also used when spikes are used as fastenings (lines of the Austrian Federal, Finnish State, and Netherlands Railways).

such sole plates is of particular value when the sleepers are not of hard wood.

On most lines, however, the rails rest directly on the sleepers. 7 Administrations sometimes insert, between the foot of the rail and the sleeper, a wooden packing (oak, azobé, compressed impregnated poplar).

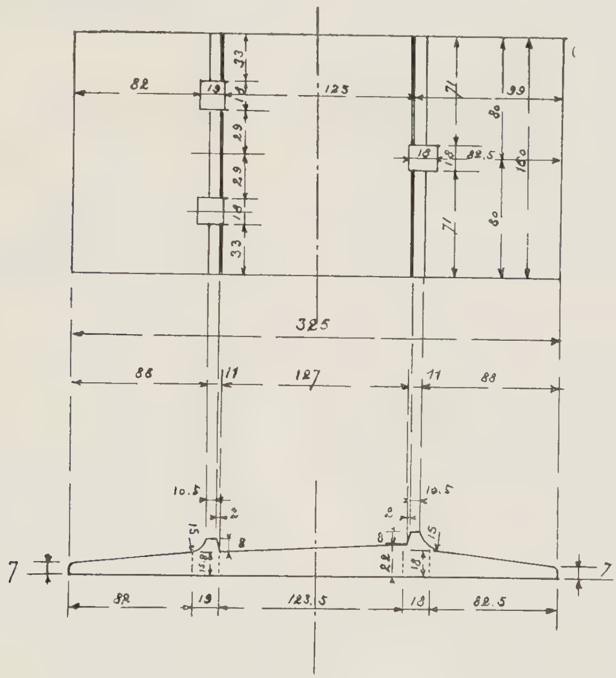


Fig. 4. — Metal bearing plate, Finnish State Railways.

23. *Chairing surfaces.*

The rails, which are of the Vignoles (flat-bottomed) type on the majority of the railways, rest on metal sole plates on the lines belonging to 5 Administrations. In this case, these sole plates generally have two parallel surfaces, which makes it necessary to cut the sleepers with a cant; on the other hand, 3 Administrations (Finnish State, Norwegian State, and Rhaetian Railways) use sole plates whose upper side has a 1 in 20 or 1 in 16 cant (Fig. 4 shows an example of such a sole plate adopted by the Finnish State Railways). The use of

The Netherlands Railways make a distinction between their spiked track on which steel sole plates are used and the « Est » track where poplar packings are used; the sleepers on the latter are not chaired and their maintenance simply consists of replacing the poplar packings every 2 to 5 years; when the chairing surface is very worn, thick packings are used; the life of a sleeper is thus about 25 years.

The Norwegian State Railways sometimes insert, between the rail and the sole plate, packings consisting of compressed cardboard impregnated with ashphalte, and about

2 mm (5/64 in.) thick. They also use spring washers between the coachscrews and the metal sole plates.

Some railways remedy any lack of tightness in the heads of coachscrews by using lugs or « Ramy » cleats.

The essential maintenance operation is re-adzing the chairing surfaces (generally using a special type of saw or wood chisel), to enable the head of the coachscrew to be tightened up against the rail. In addition, when faulty cant of the rail is due to a defect in the cant of the chairing surface of the sleeper, the latter is recut, after the rail has been removed, except on certain railways (viz. Tunisian Railways, who remove any sleepers with this defect and re-use them on secondary lines.

24. *Consolidation of the sleepers.*

Repairs to split sleepers are made, by 8 Administrations, by means of steel S pieces, driven in at the end, or by bolts; by 10 Administrations, by means of flat or round steel hoops bound round the ends of the sleepers on the line, after the split has been closed up.

12 Administrations stated that they do not strengthen any sleepers; some of them (North of Milan, Swedish State) state that the question of split sleepers does not occur on their system.

25. *Special devices to prevent gauge-widening on curves of small radius.*

The following devices are used :

Metal tie plates used over the whole of certain lines (5 Administrations, see above, paragraph 23), or only on certain sections with many curves, or on certain curves only (3 Administrations);

— Wooden wedges coachscrewed to the sleepers on the outside of the track (3 Administrations : Netherlands Railways, Swedish State Railways and Portuguese Railways; the latter state that they use Barberot wedges);

— Steel stops, coachscrewed onto the sleepers;

— « Standard Est type » stops or S E I clip type wedges (5 French Administrations);

— « Ramy » cleats mentioned under paragraph 23 (4 Administrations);

— Steel ties (Rhaetian Railway and Finnish State).

The radius of curves where such devices are used vary as follows according to the railway :

— on standard or wide-gauge lines : 750, 600, 400 and 300 m (37.5, 30 20 and 15 chains);

— on narrow gauge lines : 150, 120 and 100 m (7.5, 6 and 5 chains).

11 Administrations do not make use of any special devices.

26. *Metal sleepers.*

The Railways whose lines are laid on metal sleepers, either throughout, or over long lengths (Western African, Equatorial African, Franco-Ethiopian, Greek State, Rhaetian, Viège-Zermatt, Tunisian Railways) state that such sleepers require very little maintenance apart from tightening up the bolts of the sleeper clips. Some of them do not carry out any repairs. Others limit themselves to making adjustments in the case of accidental deformation and to inserting wedges in the slots by the heels of the sleeper clips. The Austrian Federal Railways weld any cracks and repair worn surfaces by welding on plates and re-drilling. The Tunisian Railways insert poplar packings between the rails and the sleepers, but these have not proved satisfactory owing to their short life (one to three years) and are to be replaced by grooved rubber pads.

The French General Light Railways Company is trying composite sleepers made from a 2 m (6 ft 6 3/4 in.) section of old rail and two wooden blocks 0.90 m (2 ft 11 1/2 in.) long, which appear to be very cheap to maintain.

27. *Concrete sleepers.*

Very few concrete sleepers are being used. They have been laid either on short sections in the main lines or in sidings.

The maintenance operations reported consist of replacing the bearing plates inserted between the sleepers and the rails.

The Tunisian Railways made the same remarks in this connection as those reported under paragraph 26.

C. *Maintenance of the level and alignment.*

28. *Maintenance of the level.*

a) The level of the line is corrected by *tamping the sleepers* on the lines of 22 Administrations. This is generally done by hand. The Franco-Ethiopian Railway states that tamping gangs of 4 men tamp the same sleeper together. Some Railways use mechanical tampers (see below paragraph 44).

b) « *Measured* » *shovel packing.* — (Which consists in measuring the visible defects of level sags in the running between surface of the rails), and invisible ones (voids under the sleepers), and adding the exact amount of fine gravel needed to exactly remedy them — is used on the lines of the 7 Administrations mentioned below :

France :

National Railways Company (on all lines);

Departmental Railways Company (on certain standard-gauge lines);

General Light Railways Company (on most standard-gauge lines and narrow-gauge lines where broken stone ballast is used);

R. A. T. P. (only on one Paris suburban line, the traffic on the metropolitan system making it difficult to use this method);

North Eastern Secondary Railways (on certain standard-gauge lines);

Tunisian Railways (on all the important lines).

Luxemburg :

Luxemburg Railways (on all lines).

The Austrian Federal Railways are proposing to put this method as an experiment. On the lines with little traffic, known as « co-ordinated » lines of the French National Railways Company, continuous packing is used to restore the level in the case of a general drop in the level, and by limited packing at the joints when only the joints have dropped, which is carried out much more quickly.

All the Railways which have adopted this method have found it satisfactory; it is generally considered to have technical advantages over tamping (conservation of the shape of the sleepers bed, very accurate levelling) as well as economic advantages (better output from the labour, whilst proving less fatiguing to the men). On the other hand, certain Administrations have given it up owing to the high cost of supplying the necessary packing gravel, at least when done for the first time. The Portuguese Railways state, in this connection, that they have had to give it up since they cannot get any gravel at a low price, and in addition they think that caking occurs quickly, making drainage difficult. This last drawback has not been mentioned by any other Administration.

29. *Maintenance of the alignment.*

On most of the lines operated by 17 Administrations, the versine method is used (measuring the versines by means of a cord of a given length, plotting the diagrams of the versines so measured and of the correct versines, and calculating therefrom the amount of deviation from the true alignment).

The Netherlands, Emmental-Burgdorf-Thun, and Rhaetian Railways use the « Nalenz » method of the angles diagram. For this purpose the last mentioned Company use a « Matisa » calculator.

Two Administrations (North of Milan and Viège-Zermatt) find the alignment by using a theodolite by the abscissae and ordinates. The latter Company considers that this is the quickest method, where the curves are short and of small radius.

The new alignment thus obtained is generally marked on the bed with wooden

pegs, sections of old rails, or small concrete posts.

The « Mauzin » machine, which makes it possible to correct the alignment immediately without calculations by recording the versines, is used on certain standard-gauge lines of the French General Light Railways Company and the North-Eastern Secondary Railways Company.

The « Me-Di-Co » rectifying machine is used on the Lower-Congo to Katanga Railway and the Franco-Ethiopian Railway, and the Viège-Zermatt Company is also considering using it.

D. *Maintenance of the ballast and formation.*

30. *Cleaning the ballast.*

Whereas 4 Administrations do not clean the ballast at all, this is done by hand-forking it on 14 Railways and by screening it on 5 Administrations. This operation is not usually part of the general overhaul, which proceeds at a different pace.

On two Railways, any dirty ballast is replaced (Danish State and North of Milan) and on two others (Swedish State and Netherlands) where the ballast consists of gravel and sand respectively, by adding to it.

If the ballast is not very dirty, the Tunisian Railways merely shovel-pack it for 10 mm (3/8 in.) in order to keep the dirty ballast away from the sleeper, until it is cleaned; where the ballast is very dirty owing to sand storms or because earth has been carried down by storms or floods, an integral overhaul is carried out the following year, the ballast being cleaned by hand.

Finally, the Finnish State Railways clean the banks by means of special ploughs.

31. *Weeding the bed.*

Nine Administrations practice hand weeding;

Nineteen Administrations go in for chemical weed-killing;

Three Administrations use mechanical weeders.

a) *Chemical weed-killing.*

The weed-killer used is chlorate of soda dissolved in water, either alone or mixed with other products : 13 Administrations use it by itself, 2 Administrations use a mixture of chlorate of soda and sodium chloride (in the proportions of 66 % or 80 % of chlorate of soda), 1 Administration uses a mixture of chlorate of soda and magnesium chlorite (60 % of chlorate of soda); 1 uses either « Occysol », or chlorate of soda by itself, and 3 use « Tursal »,

The concentration of the solution varies from 150 to 10 gr of chlorate of soda per litre (23.5 to 1.57 ounces per Br. gall.) (see the table below) according to whether it is spread by atomizing or by ordinary spraying. The quantity of liquid sprayed varies from 0.10 to 1.5 litres per square metre (0.0736 to 1.10 quarts per sq. yard).

The quantity of dry weedkiller spread varies according to the climate, and the kind and amount of vegetation from 10 to 30 gr per sq. metre (0.295 to 0.885 ounce per sq. yard); it is usually 15 to 20 gr (0.442 to 0.59 ounce per sq. yard).

The North-Eastern Railway Company (France) reports that it generally uses the following quantities of weedkiller :

	Chlorate of soda		« Occysol »	
	gr per m²	oz. per sq. yd.	gr per m²	oz. per sq. yd.
Sparse vegetation . . .	12	0.354	15 to 20	0.442 to 0.59
Average vegetation . . .	15	0.442	20 to 25	0.59 to 0.737
Abundant vegetation . .	18 to 20	0.531 to 0.59	20 to 35	0.59 to 1.02

Particulars regarding chemical weedkilling.

Administrations	Solution used kg per m³ or gr per litre	Quantity of solution spread per m². Litre	Quantity of dry weedkiller used per m². Grammes
Chlorate of soda alone :			
AUSTRIA : *Federal Railways*	—	—	20
BELGIUM : *National Light Railways Company*	20	0.75 to 1	15 to 20
FRANCE : *National Railways Company (S.N.C.F.)*	150	0.10	15
Departmental Railways Company	—	—	20
General Light Railways Company	150 45	0.10 to 0.13 0.33 to 0.44	15 to 20
Northern Light Railways	17 to 34	1	17 to 34
R. A. T. P. (Paris, elevated sections)	50 to 100	0.20	10 to 20
North-Eastern Secondary Railways Co	150	0.08 to 0.13	12 to 20
Tunisian Railways	67	0.22 to 0.45	15 to 30
GREECE : *State Railways*	85	0.26	22
LUXEMBURG : *Luxemburg Railways*	—	—	10
NORWAY : *State Railways*	20 to 30	1	20 to 30
SWEDEN : *State Railways*	30 to 60	1	30 to 60
Chlorate of soda mixed with other salts :			
FRANCE : *General Local Railways Company (V. F. I. L.)* (1)	200	0.15	30
ITALY : *North of Milan Railways* (2)	90 to 110	0.20 to 0.25	22
NETHERLANDS : *Netherlands Railways* (3)	200 50	0.045 0.18	9 9
FRANCE: *North-Eastern Secondary Railways Company* (4)	280	0.053 to 0.125	15 to 35
SWITZERLAND : *Rhaetian Railways* (5)	10	1.5	15
Viège-Zermatt Railways (5)	—	—	—
Emmental-Burgdorf-Thun Rw. (5)	—	—	—

(1) 200 gr of chlorate of soda per 100 gr of sodium chloride.

(2) 400 gr of chlorate of soda per 150 gr of sodium chloride.

(3) 60 % of chlorate of soda and 40 % magnesium chloride.

(4) « Occysol »;

(5) « Tursal ».

The Tunisian Railways use the weedkiller twice at intervals of 2 or 3 months, the first time when the vegetation begins to appear; at the end of the 3rd year, the weedkiller is only used once. The quantities of chlorate of soda spread are :

Track not yet treated with chlorate : 1st time : 30 gr per m^2 (0.885 oz. per sq. yard); — 2nd time : 20 gr per m^2 (0.59 oz. per sq yard);

Track on which weedkiller was used the previous year : 1st time : 25 gr per m^2 (0.737 oz. per sq. yard); — 2nd time : 20 gr per m^2 (0.59 oz. per sq. yard);

Track on which weedkiller has been used for the last 2 years : 1st time : 25 gr per m^2 (0.737 oz. per sq. yard); — 2nd time : 15 gr per m^2 (0.442 oz. per sq. yard);

Track on which weedkiller has been used for the last three years : only one spraying, 25 gr per m^2 (0.737 oz. per sq. yard).

b) *Mechanical weeding.*

Weeding is only done mechanically by 3 Administrations.

The Departmental Railways Company (France) limits it to the sides of the bed on certain lines, using a single-wheeled motor cultivator.

The Northern Light Railways (France) use a weedkiller mounted on a heavy truck and to complete the work, a screen to collect and crush the weeds, mounted on another truck. Where there are many weeds, a gang of 8 to 10 men can deal effectively with 3 km (1.86 miles) of track a day. The cost of the work is 0.92 fr. per square metre, whereas weedkilling with chlorate of soda costs 3.33 fr. or 1.92 fr. according to the strength of the solution (1 kg for 30 or 60 litres spread at the rate of 1 litre per square metre, i. e. 17 or 34 gr of chlorate of soda per square metre (0.50 or 1 oz. per sq. yard).

The Netherlands Railways also resort to mechanical weeders in certain cases.

32. *Drawing up maintenance programmes and checking the way they are carried out.*

Most railways draw up, every year, after examination by the officials of the various grades, a programme laying down the parts of the line due for a general overhaul and, if needs be, a limited overhaul, and giving, as a rule, the work to be carried out every month according to its urgency (calender-programme),the sequence often being shown diagrammatically on a graph. A table also gives, for each section of line, the estimated number of man-days and the amounts of materials required. This annual programme is sometimes completed by a monthly programme, giving full details every month of the work to be carried out in the suceeding month, taking into account the most urgent requirements.

The way the work is carried out is followed up on many railways by means of graphs showing by means of different colours or cross hatching the different sections covered by the general overhaul or limited overhaul (Fig. 5), sometimes showing the output, levelling by shovel packing, number of sleepers replaced, etc. The graphs prepared by certain Railways show each line or section, for which a gang is responsible, by a certain number of horizontal bands; each of these corresponds to a given date in the year,and is coloured as the work is completed. The monthly progress sheet of a progress calender-programme also shows the number of days devoted to the different kinds of work, the materials used, and the progress of the different kinds of work.

Checking the results obtained is generally done by inspecting the work on foot or by truck and, on 5 Railways, by computing the readings given on tables or check slips, or by periodically running recording equipment over the track.

The French National Railways Company considers that on its « co-ordinated » lines the track-testing equipment showing any warping, deviations from the gauge, low points, etc.., plays a very important part, especially if recording, both in preparing the programme and checking and supervising the work during the year

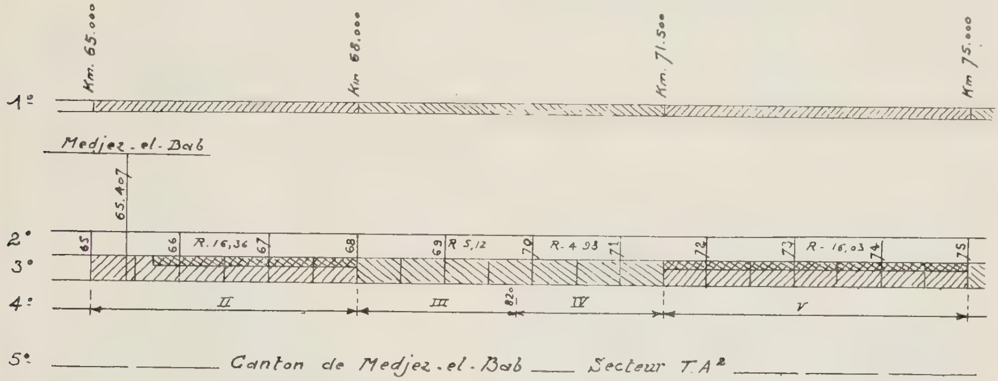
The « Hallade » recording machine, put in the fastest trains, is run over the main lines of the Tunisian Railways every 6 months. The same machine is also used

on the Western African and the Equatorial African Railways and by the Swedish State Railways (every 4 years on the secondary lines).

The North-Eastern Secondary Railways (France) use a « Deville » machine on some of their lines.

the axle-loads, the greater is the tolerance for wear.

b) *Lateral wear.* — On certain railways, the limits allowed for vertical wear are reduced by half the lateral wear of the head of the rail, measured 15 mm (5/8 in) below the running surface.



DIRECTIONS. — 1° Program { ////// — Limited overhaul. \\\\\ — General overhaul.

2° Mileage, stations, and output.

3° Work done, same hatchings as for the program — × × × × Shovel packing.

4° Month during which work is carried out.

5° Limits of sections and gangs, lengths.

Fig. 5. — Maintenance work graph (Tunisian Railways).

33. *Tolerances allowed on the basic figures for the permanent way and its equipment.*

Wear of rails.

a) *Vertical wear.* — The maximum wear allowed varies as follows, according to the Railways, for the different types of rail :

— from 5 to 10 mm (3/16 to 3/8 in.) for 20 kg. (40 lbs. per yard) rails;

— from 6 to 13 mm (1/4 to 1/2 in.) for 25 kg (50 lbs. per yard) rails;

— from 8 to 14 mm (5/16 to 9/16 in.) and even 17 mm (11/16 in.) for 30 kg (60.4 lbs. per yard);

— from 10 to 14 mm (3/8 to 9/16 in.) for 35 and 36 kg (70.5 and 72.5 lbs. per yard) rails;

— from 15 to 20 mm. (5/8 to 13/16 in.) for 45, 46 and 49 kg (90.7, 92.7 and 98.8 lbs. per yard) rails.

For a given weight of rail, the smaller

On a greater number of railways, the limits of lateral wear are fixed, according to the type of rail, between 3 and 16 mm (1/8 and 5/8 in.).

Sleeper thickness after recutting.

The minimum thickness of sleepers allowed, after recutting is 7, 8 or 9 cm (2 3/4. 3 1/8 or 3 1/2 in.), according to the Railway, and exceptionally 10 or 11 cm (3 15/16 and 4 3/8 in.).

Gauge of the track.

Within the outer limits of the gauge fixed for 1.432 m to 1.465 m or 1.470 m (4 ft. 8 1/2 in., 4 ft. 10 13/16 in., and 4 ft. 10 1/8 in., Standard gauge track and for 0.995 to 1.025 or 1.030 m (3 ft. 3/16, in., 3 ft. 4 3/8 in., and 3 ft. 4 9/16 in.), metre-gauge lines, various Railways have laid down maintenance tole-

rances compared with the prescribed track gauges. These vary from 5, 4, 3 or 2 mm (3/16, 5/32, 1/8 or 5/64 in.) less to 5,7 or 10 mm (3/16, 9/32 or 3/8 in.) (exceptionally 20 to 25 mm = 13/16 to 1 inch) more, (the limits of 3 mm less to 10 mm more being those most frequently allowed). The maximum variation in the gauge is sometimes fixed at 3 mm (1/8 in.) between two consecutive sleepers.

Variations in the level.

a) The amount of out of level allowed in the track is generally from 2 to 3 mm per metre (1 in 500 to 333). Exceptionally it is limited to 1 mm (1 in 1000), whilst on the other hand it may be as much as 5 mm (1 in 200) and even 6 mm per metre (1 in 166) between two points at least 3 mm (9 ft. 10 1/8 in.) apart.

b) The limits allowed for incorrect superelevations, given by some Administrations, generally lie between 10 mm (3/8 in.) below, and 10 mm above the fixed readings; they can be 20 mm (13/16 in.) more or less on one Railway.

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III. MODERNISATION OF THE EQUIPMENT.

A certain number of Administrations are using mechanical devices, either systematically, or still merely for trial purposes, those amongst those that do not use such machines, some (Danish State Railways) are considering introducing them on their secondary lines, according to the experience acquired on the main lines; the Viège-Zermatt Railway does not propose to introduce them owing to the small size of its installations, lack of mechanical knowledge amongst the workmen in the remote valleys, and the need for having a large number of men available all the time owing to the hazards to which this mountain railway is exposed from the weather.

A. *Tools and machine tools for the maintenance of the rails and joints.*

34. *Drilling the rails.*

13 Administrations use hand tools (ratchet); 10 Administrations use mechanical drills worked by means of a cranked handle and incorporating reduction gear. The machines mentioned are:

- the « Robel » drill (Belgian Light Railways, North of Milan, Portuguese and Rhaetian Railways);
- the « Renert » drill (North-Eastern Secondary Railways, France). (Fig. 6);
- the « Avos » machine (Swedish State Railways). (Fig. 7);

Five Administrations use power driven drills :

- either electric : Northern Light Railways (France);
- R. A. T. P. (1 HP) d. c. « Wageor » drill working:
- on 240 V (suburban lines), 70 r. p. m. (using a 9 HP generating set);

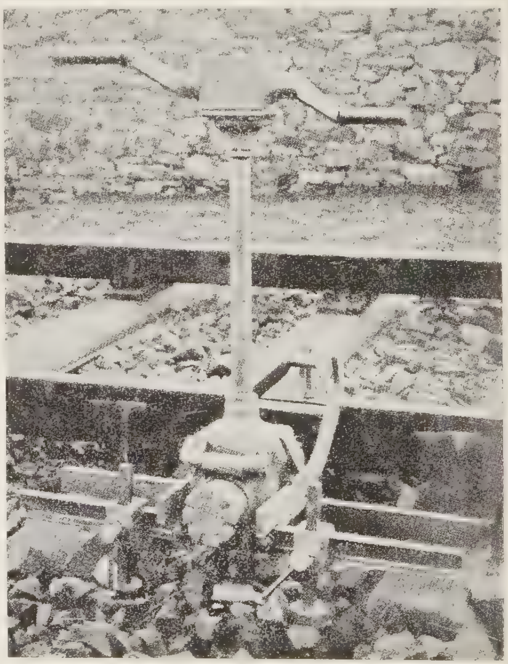

Fig. 6. — « Renert » rail drill (North-Eastern Secondary Railways).

— on 600 V (Metro, Paris), 50 r. p. m. (current supplied by the lighting circuit);
— or pneumatic (Greek State Railways);
— or petrol-engine driven : Tunisian Railways (Jami engine); Emmental-Burgdorf.

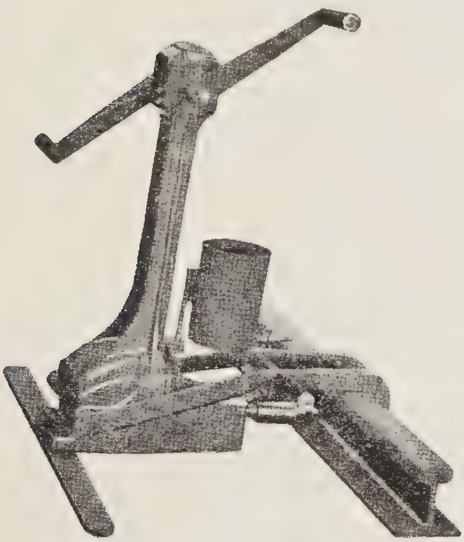

Fig. 7. — Avos rail drill (Swedish State Railways).

The Northern Light Railways also make use of a blowpipe (round hole completed by drifting).

The output is given by the Tunisian Railways as :

2 holes an hour with a hand drill;

5 holes an hour with a motor drill.

The R. A. T. P. (Paris) reports that output is three times as much as with hand drilling.

These machines are not very widely used, owing to the small quantity of holes that have to be drilled in the rails at any maintenance point.

35. *Sawing rails.*

The same applies to sawing rails :

— Seventeen Administrations use hand saws;

— Six Administrations use hand-operated sawing machines, amongst them :

— the « Robel » saw (North of Milan, Portuguese, Rhaetian Railways);

— the « Avos » equipment (Swedish State) (Fig. 8).

Two Administrations use motor-driven equipment (Emmental-Buirgdorf, Greek State); the latter Administration states that a 1/4 HP petrol engine is used.

The Northern Light Railways (France) cut rails by means of a blowpipe.

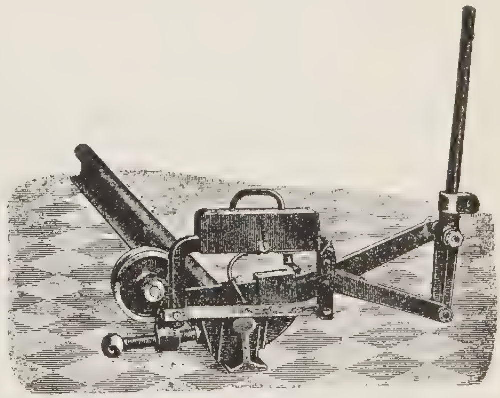

Fig. 8. — Avos rail saw (Swedish State Railways).

36. *Pulling the rails back.*

To regulate joints that have got out of place owing to creep, seven Administrations use « joint-pulling » machines with opposed threaded screws and pins, which fit into the holes of the rails.

The types of machines mentioned as :

— « Schollaert » (R. A. T. P., Paris).
— The « Rapide » (General Light Railways Company, France);
— « Robel » (Portuguese Railways);
— « Berg and Co. », Lindesberg (Swedish State).

37. *Tightening up the fishplate bolts.*

Most Railways use ordinary spanners. Those used on the Tunisian Railways are of two sizes; a long one to loosen the nut, and a short one to turn it rapidly.

The Portuguese Railways also use ratchet spanners of the Robel type.

38. *Welding joints, building up the ends of rails and frogs.*

Certain Railways have the classic alumino-thermic equipment (the Tunisian Railways use a Bernard set for the annealing) others contract this work out to specialist firms (R. A. T. P., General Light Railways Company).

Three Railways state that they use portable generating sets for this purpose :

— the Belgian Light Railways Cy (petrol or electric motors);

— the Portuguese Railways (Diesel engines with a petrol driven machine for preparing and finishing off the work; these devices enable the work to be done very rapidly, which makes the welding economical);

— the Tunisian Railways (Wilson-Yellow-Jacked 40 V, 400 A welding set worked by a 6-cylinder Crysler petrol engine).

To built up the ends of worn rails by electric-arc welding, carried out by its own employees, the Paris Metropolitan has a converter set installed in a specially equipped motor coach, with the following characteristics :

Thomson shunt excited motor, 600 V, 49 A, 800 r. p. m., fed by the traction current;

SAF generator, 60 V, 1 450 r. p. m.; welding current can be regulated between 75 and 375 A.

The Northern Light Railways grind or plane the surface of metal added to the rails (Fig. 9).

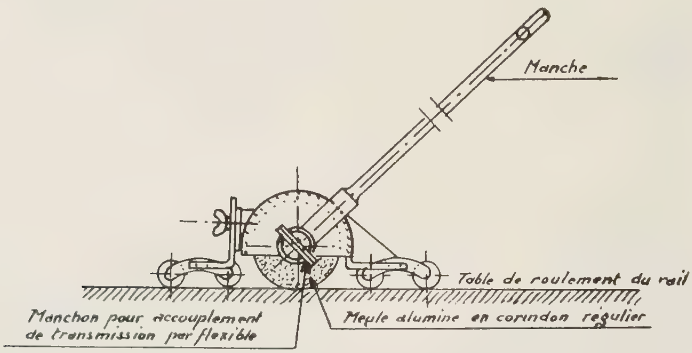

Fig. 9. — Milling machine for built-up rails (Northern Light Railways).

Explanation of French terms; — Manche = Handle. — Manchon pour accouplement de transmission par flexible = Sleeve for gear coupling with Bowden wire. — Meule alumine en corindon régulier = Alumina planing wheel of standard corundum. — Table de roulement du rail. = Running surface of rail.

B. *Tools and mechanical plant for the maintenance of the sleepers and fastenings.*

39. *Drilling the coachscrew holes.*

The majority of railways use hand augers; some of them have replaced these by drills which nearly double the output. Some railways also use reamers in the shape of a truncated cone, to open out the upper parts of the holes.

The mechanical plant used on some railways is driven either by electric or petrol motor :

a) Electric drills.

To drill sleepers which have not been impregnated and so have not come from a shop in which they were chaired and drilled, it is an advantage to use electric drills which can be run off the electric supply available on the job. The General Light Railways Cy use 500-watt drills which can completely machine a sleeper

in 10 minutes (the actual notching having been done by hand), whereas this took 20 minutes with an auger and 15 minutes with a drill.

The North of Milan Railways use portable electric drills mounted on a frame, which ensure the holes being drilled perpendicularly to the bearing surface.

The R. A. T. P. (Paris) redrill the old sleepers on their Paris suburban lines by means of a Micox electric drill (3/4 HP, 110 V a. c. — 2 speeds, 250 and 500 r. p. m., fed from the signal current), the output of which is 5 or 6 times as great as that of hand drills.

b) Petrol motor driven drills.

The types mentioned by the Railways (respectively : the Departmental Railways Company, General Light Railways Company, and Tunisian Railway) are the following :

— Collet motor drill, 3.5 HP motor;

— Pouget, motor drill, 3 HP motor;

— Jami, motor drill, 2.4 HP motor.

The Departmental Railways use this tool for re-drilling done on the line during the general overhauls, and on the systems whereon the sleepers are not chaired by machine, to drill them, as well as re-drilling the sleepers that are being re-used. The machines are sent from line to line, as required.

The output mentioned by the railways using the appliances is 300 to 400 holes an hour, whereas only 20 to 40 holes an hour can be drilled by hand.

40. *Driving and removing the coachscrews.*

Some of the French Railways (National Railways Company, General Light Railways Company, North-Eastern Light Railways) use the Lompret-Guille hand-operated mechanical coachscrew drivers, worked by 2 men, which facilitate the work as compared with a spanner, owing to the fact that less muscular effort is required of the men; it is especially advantageous for the periodic tightening up of the fastenings.

The following motor-driven tools are used :

a) Electric coachscrew drivers, used by the 3 following railways :

— Australian Federal Railways;

— Norwegian State Railways (Robel coachscrew drivers);

— R. A. T. P. (Collet coachscrew drivers fitted with 2 HP, d. c. motors working:

  — on 240 V, on the suburban line, 4 000 r. p. m., from a 9 HP motor-generator set;

  — on 600 V on the Paris Metro, 4 000 r. p. m., on current supplied from the lighting supply.

The output obtained is 6 to 8 times greater than with hand coachscrew driving.

b) Petrol-engine driven coachscrew drivers.

The types mentioned by 6 Administrations (Departmental Railways, North-Eastern Secondary Railways, General Light Railways Company, Tunisian Railways, North of Milan, and Lower Congo-Katanga) are respectively :

Collet motor coachscrew driver (Fig. 10), engine power, 3.5 HP;

Pouget motor coachscrew driver, engine power, 5 HP;

Jami motor coachscrew driver, engine power, 6 HP;

Berengo de Maistre motor coachscrew driver, engine power, 5.5 HP;

Matisa coachscrew driver.

The Departmental Railways equipped all their lines with a motor-driven coachscrew driver in 1939, at the beginning of the war, to make good the loss of men being called up. They are used for all the current maintenance operations (tightening up fastenings, general overhaul, reconditioning the track if the working site is at least 60 m = 66 yards long. The men very soon got used to them. Each of these tools, which are passed from gang to gang as the work proceeds, works about one day in

four. Their main characteristics are as follows :

Mounted on a wheeled truck with hinged handle;

Single-cylinder petrol engine of 3.5 HP;

Automatic engaging and releasing of gear, making it possible to tighten a coachscrew right up without any risk of stripping the thread;

Weight : 102 kg (225 lb.);

1 man needed to drive it;

Consumption :

petrol : 0.800 litre (1.44 Eng. pint) an hour;
oil : 0.040 litre (0.07 Eng. pint) an hour;
grease : 1 kg (2.2 lb.) a month.

Rate of progress : 200 m (218 yds.) an hour, or about 500 coachscrews on one rail file (whereas, with an ordinary spanner, a man can tighten up about 60 coachscrews an hour).

The economy obtained, after deducting the cost of using the tool (labour, depreciation, consumption and maintenance) represents about one man's wages.

The Departmental Railways conclude that the motor coachscrew driver saves one man in a gang of 6 men, whilst giving better technical results than with hand labour.

The French General Light Railways Company considers that it is advisable to have an engine with plenty of spare power (5 HP) to prevent it stalling when the coachscrews go home or when trying to undo them.

The number of coachscrews that can be completely removed or screwed in is also about 500 an hour.

The Tunisian Railways state that the output of their two motor coachscrew drivers which have a 6 HP engine, is as follows :

150 to 200 coachscrews can be tightened up in an hour, compared with 20 to 30 with an ordinary spanner; 300 to 400 coachscrews can be removed in an hour, compared with 50 to 60 by means of a spanner.

The North of Milan Railways state that their motor coachscrew driver, operated by 2 men, makes it possible to remove or tighten up a coachscrew in 10 seconds in a completely satisfactory way, whereas with hand labour it takes 2 men 2 minutes, and that, consequently, the use of this tool, when a general overhaul is being carried out on a section with a gang of 30 men, makes it possible to save 5 or 6 men.

Fig. 10. — « Collet » power-driven coachscrews spanner (North-Eastern Secondary Railways).

41. *Truing up rail seats on the sleepers.*

On nearly all railways, this is done by hand, using adzes, saws and wood chisels. The Northeastern Secondary Railways and the Emmental-Burgdorf-Thun Railway have used, for some years, and the General Light Railways Company is shortly going, to use mechanical shapers for re-cutting the shoulders, which do the job much faster and better than by hand.

These mechanical shapers are of two types : Collet (Fig. 11) and Pouget, worked by petrol engines of approximately 3 HP.

Fig. 11. — « Collet » power-driven adze.

42. *Consolidation of the sleepers.*

Cracks in sleepers are made good on several Administrations by using hooping machines of the Delor, Gibert and Streit types (Fig. 12 and 13); the former allowing of the fastening of flat steel hoops (bands) to the ends of the sleepers, and the two others round steel bands.

C. *Tools and plant for rectifying the level and alignement.*

43. *Lifting the track.*

In addition to the rack and pinion jacks operated by a handle, which are the most generally used (Fig. 14), 8 Administrations use Robel (Fig. 15), or Renert, ratchet type lifting-jacks, which are more practical, lighter, can be removed from the line on the approach of a train, and make it possible to let the raised-up track fall abruptly, which ensures a better seating of the sleepers on the gravel when shovel packing is used.

The Austrian Federal Railways report that they use various types of jacks worked by a handle with ratchet, or by means of a box-spanner.

44. *Tamping.*

On most Railways tamping is done by hand with steel or wooden tampers, rammers, shovels or forks, according to the kind of ballast used. Some of them use, or are going to use, mechanical tampers of the following types:

— the Krupp tamper (Austrian Federal and North-Eastern Secondary Railways);
— the Scheuchzer tamper (Franco-Ethiopian Railway);
— the Matisa tamper (Lower Congo-Katanga, and Tunisian Railways);
— the Jackson tie tampers (Norwegian State).

The Greek Railways are considering the introduction of a pneumatic tamper. The

Matadi-Léopoldville Railway is considering the use of a mechanical tamper.

45. *Shovel packing.*

The typical equipment of a « measured shovel packing » gang is as follows (French National Railways Company, Departmental Railways, General Light Railways Company, R. A. T. P. (Paris) on their suburban line, North-Eastern Secondary Railways, Tunisian Railways and, very shortly, the Austrian Federal Railways):

8 to 16 dansometers (varying according to the traffic) with a gauge;

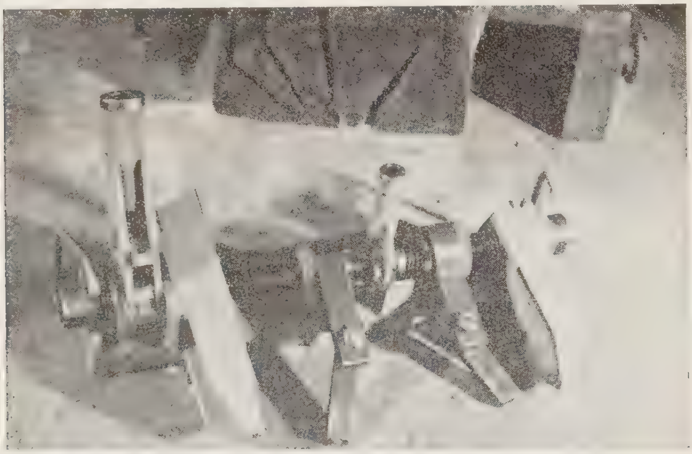

Fig. 12. — « Streit » press for hooping sleepers (North-Eastern Secondary Railways).

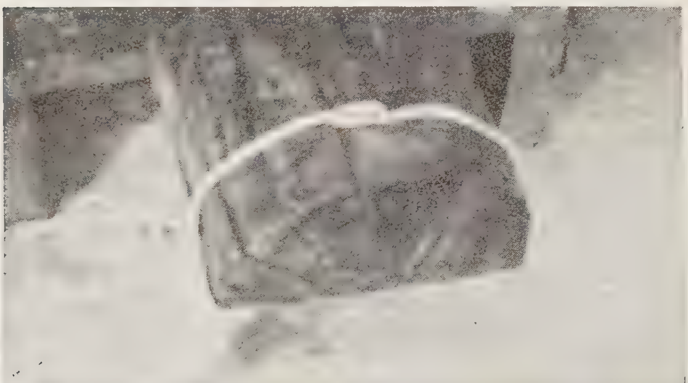

Fig. 13. — Hooped sleeper (North-Eastern Secondary Railways.)

1 measuring rod;

1 Lemaire telescopic viewfinder and its levelling staff, with wedges 1 to 10 mm ($^{3}/_{64}$ to $^{3}/_{8}$ in.);

2 packing shovels;

2 measuring shovels;

1 measuring box;

2 gravel bins;

2 gravel buckets;

4 jacks (of the lever type if possible);

1 superelevation gauge;

1 platelayer's level.

Fig. 14. — Rack and pinion rail jack (North-Eastern Secondary Railways).

46. *Recording the versines.*

Some Railways have « Mauzin » and « Me-Di-Co » equipment, as described in paragraph 29.

The Rhaetian Railway measures the versines by means of precision device consisting of a fine, stiff cord exactly 10 m (32.9 ft.) long, held taut by iron brackets between two wooden jaws, and a white jcale with a brass bracket, the scale and the saws having air levels.

D. *Tools and plant for the maintenance of the ballast and formation.*

47. *Chemical weeding.*

This is done :.

— either by a weedkilling train (French National Railways Company, North of Milan); on the latter railway, this train consists of 4 tank wagons which contain respectively : the first, a concentrated chemical mixture, the second pure water (together with the spraying equipment), the third the solution as sprayed, and the fourth the spraying solution and the sprayer;

— or by a tank of 10 to 15 cubic metres (2 200 to 3 300 Br. gall.) capacity, hauled by a 60 to 80 HP motor trolley (North-Eastern Secondary Railways, Tunisian Railways),running at a speed of about 10 km (6.2 miles) an hour;

Fig. 15. — « Robel » lever jack for track lifting (North-Eastern Secondary Railways).

— or by a tank or vat on a wagon hauled by a locomotive, with a motor pump compressing the air in the tank, by a motor-compressor, or by the brake air pump of the locomotive (Departmental Railways, General Light Railways Company (France), Northern Light Railways, Emmental-Burgdorf-Thun Railway, Norwegian State);

— or by hand with an atomizer (Vermorel type) for short sections of line (open air sections of the Paris Metropolitan, the suburban line being weeded by the French National Railway Company's weed killing truck) or for

the pavements and station sidings of certain railways.

48. *Mechanical weeding.*

This is done :

— either by a single-wheel Labor motor cultivator, with weeding and raking tools (Departmental Railways);

— or by an extirpator and screen (Northern Light Railways);

— or by an agricultural tractor and plough to make, on sections in flat country, fire-guard belts one metre (3′ 3 3/8″) wide in line with any crops, the mowing of a 3 m (9 ft. 10 in.) wide belt from the edges of the fire-guard being done by scything (Tunisian Railways);

— or by a plough to keep the banks in order (Finnish State).

A mechanical pickaxe to stir up the ballast, mounted on a locomotive, has been tried by the General Light Railways Company, but its use has not been continued.

49. *Cleaning the ballast.*

The Railways who clean their ballast use metal screens on which the dirty ballast is thrown by means of forks.

No Railway has reported the use of mechanical devices removing and-screening the ballast, the amount of work being insufficient to justify their use.

50. *Other equipment.*

The following machines were mentioned by some Administrations :

— Rake-plough operated by hand to clear away and re-spread the ballast (General Light Railways Company, North-Eastern Secondary Railways).

— Machine built by the Tunisian Railways, which makes it possible to clear away the ballast starting from the top of the sleepers outwards. Mounted on a truck, it includes two strong shares operated by a hand winch, which makes it possible to regulate the depth of penetration into the ballast. The ballast is spread back by replacing the shares by rakes. This machine is hauled by an 80 HP truck.

— Collet-Loiseau machines provided for by the Franco-Ethiopian Railway for track renewals.

— Steam or motor shovels and self-tipping or flat wagons (Finnish State Railway)s.

— Grinder on slides, to correct the corrugations on the rails (truck fitted with abrasive slippers, travelling at an average speed of 35 km [21.7 miles] an hour over the sections to be treated, used by the R. A. T. P. (Paris-Metro, and suburban line).

— Line-spreading trucks to disinfect and purify the permanent way and tunnels, used by the Paris Metro.

— A rail-bending press, with rollers, which is simple and strong, but requires 4 men to operate it (Rhaetian Railway).

51. *Organisation of the work on the line when mechanical equipment is used.*

Three examples of the organisation of track work are given below :

1. General overhaul of the fastenings and joints, using a motor-driven coach-screw spanner and adze (North-Eastern Secondary Railways).

The sleepers are adzed in four operations :

one inside the right rail;

one outside the right rail;

one inside the left rail;

one outside the left rail.

It is necessary to deal with the inside of each file of rails before the outside.

The gang must consist of 14 men to obtain the best output. It is possible, however, to carry on with 10 men :

a) 4 men : insert wedges under the coach-screws (to adze the inside files of rail only); square up displaced sleepers, rectify the gauge widening, etc...;

b) 3 men : take down, clean, grease, and refit the fishplates after adzing;

c) 1 man : operating the coachscrew spanner, removing all the coachscrews in the file of rails being dealt with;

d) 1 man : cleaning the shoulders and removing the coachscrews;

e) 1 man : operating the adzer;

f) 1 man : creosoting the shoulders;

g) 1 man : inserting the coachscrews in the holes, marking off V wedges, bushes, holes to be redrilled;

h) 2 men : bushing, placing V wedges, redrilling, tightening up the coachscrews with the coachscrew spanner.

2. General overhaul of the fastenings, using motor-driven coachscrew spanner, adzer and drill (programme of the General Light Railways Company) :

Number of men :

1 *Power-driven coachscrew spanner :* removing inside coachscrews;

1 Removing and sorting the coachscrews, cleaning the notches;

1 *Power-driven adze :* recutting the shoulders;

1 or 2 Tarring, and engaging the coachscrews (except in the bushed holes;

1 Reaming out and cleaning the holes to be bushed;

1 or 2 Bushing the holes;

1 Cutting off the tops of the bushes and cutting the shoulders alongside the fishplates;

1 *Power-driven drill :* drilling cylindrical holes in the bushes;

1 Reaming out the holes and engaging the coachscrews;

1 *Power-driven coachscrew spanner :* driving the coachscrews.

Total 10 or 12.

After having dealt with the inside of the first file of rails, the work proceeds in the opposite direction and the inside of the second file of rails is dealt with, then the outside of the first file and the outside of the second file.

3. Re-sleepering a section with gravel packing, using two mechanical coachscrew spanners : graph prepared by the Tunisian Railways (Fig. 16).

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IV. RESULTS OBTAINED.

When preparing the financial balance sheet for the maintenance of the permanent way, it is often difficult to separate the results due to each of the factors examined above : organisation of long-distance gangs, application of up-to-date methods in carrying out the overhaul, and the use of mechanical equipment.

We will, however, try to analyse the improvements and drawbacks which have resulted, from the technical, economic, and social points of view.

52. *Improvement in the quality of the maintenance from the technical point of view.*

a) *Owing to the alteration in the constitution of the gangs*, the quality of the work has definitely improved, being better organised, supervised, and checked. It is easier for the district officer to follow the work of three or four long-distance gangs than that of ten or a dozen small gangs. It is often easier to find a few *good* gangers for the long-distance gangs than the much higher number of gangers required for the small gangs.

On the other hand, men working in small gangs often have a greater corporate feeling and are more conscientious than those working in large gangs. Consequently it is necessary for the heads of the latter to display great ability in controlling their men.

b) The application of up-to-date methods makes it possible to get more accurate and, consequently, more durable work. When the work is rationally organised, no operation is forgotten, the sections of track that have been overhauled are more homogeneous and inspection is facilitated. Measured shovel packing, in particular, makes the men develop the habit of making minute corrections of the level. The same remark applies to the versine method as regards the correction of the alignment.

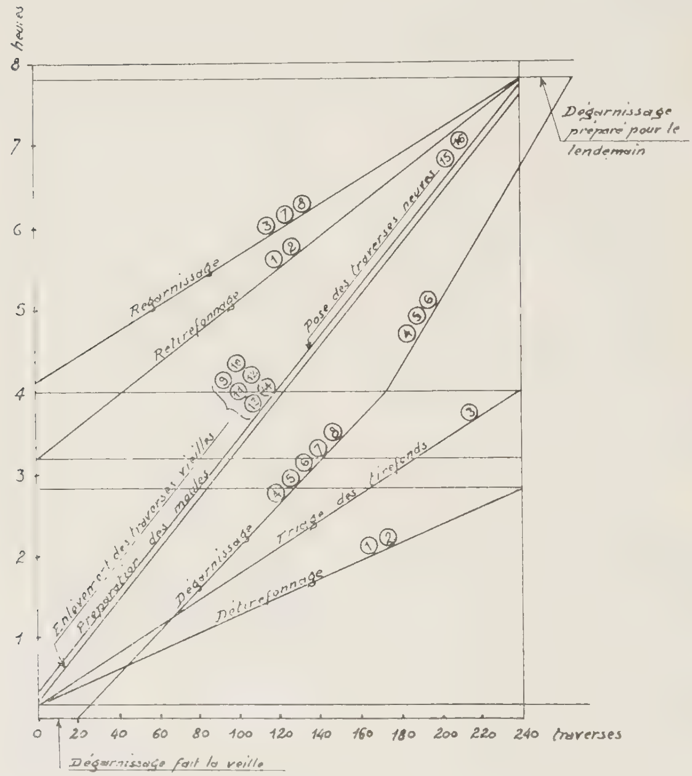
c) The use of mechanical equipment contributes to the improvement in the quality of the work; for example, the cant of the coachscrew holes is more correctly

Complete overhaul

Replacing sleepers by gravel packing.

Use of mechanical coachscrew spanners — (two)

Track length with 240 sleepers a day — (16 men)



Length of the works : 600 to 800 m.

$$\text{Output} : \frac{240}{16} = 15 \text{ sleepers per man daily}$$

Fig. 16. — Graph prepared by the Tunisian Railway Company.

Explanation of French terms. — Dégarnissage fait la veille = Ballast swept away from the sleepers the previous day. — Dégarnissage préparé pour le lendemain = Sweeping ballast away from the sleepers as a preparation for next day. — Enlèvement des vieilles traverses = Removing the old sleepers. — Préparation des moules = Shaping the sleeper beds. — Détirefonnage = Removing the coachscrews. — Pose des traverses neuves = Laying the new sleepers. — Regarnissage = Reballasting around sleepers. — Retirefonnage = Putting back and tightening up coachscrews. — Triage des tirefonds = Sorting coachscrews.

assured when a mechanical drill is used than by hand drilling; the recutting of the shoulders is carried out more regularly with a mechanical adzer than by hand tools, etc...

53. *Improvement in the maintenance, from the economic point of view, through improved output.*

a) The grouping of the staff into long-distance gangs generally leads to an economy in labour.

The Tunisian Railways report that the grouping of 6 to 10 short distance gangs into a single mechanised gang makes it possible to reduce the staff by 4 to 8 men, thus leading to a saving of 5 to 15 %. From this saving must be deducted the cost of running the trucks or lorries; this Company reports that for one machine, it is equivalent to about a platelayer's wages.

However, if a long-distance gang is to prove satisfactory, the following conditions must be fulfilled :

— the ganger must be a good leader;
— grouping the staff at headquarters or close thereto;
— high-speed and unimpeded transport;
— the track must be in a normal state of repair, without too many weak spots which would lead to dispersal of the staff.

It appears, therefore, that if the above conditions cannot be fulfilled, it may sometimes be better to retain the small gangs.

Thus, amongst the Administrations remaining faithful to rational organisation, the General Local Railways Company considers that if the output per man of a gang does not increase above 4 units, there is no point in having gangs of more men than that number. They state definitely that if the output of a man is taken as one unit, that of the different gangs can be set out as follows :

Gang of two men, output 1.5;
Gang of three men, output : 2.5;
Gang of four men, output : 4;
Gang five men, output : 5;
Gang of six men, output : 6.

b) *Owing to the application of the new methods*, the output of work has been considerably improved, as is proved by the figures given by several Administrations.

The output obtained, however, varies considerably from railway to railway, as it depends upon various factors, especially the climate and geographical situation, the quality of the labour available, the equipment and state of the track, the kind of ballast, etc...

The General Light Railways Company (France), when they introduced long-distance gangs, equipped with motor trucks and applied the general-overhaul method, some twenty years ago, reduced the maintenance staff by about 25 %. The length of line dealt with under the general-overhaul system varies, per man per working day of 8 hours, from 6 to 7 m (6.56 to 7.65 yds) (broken-stone ballast) to 10 m (10.9 yds.) (sand ballast). The substitution of measured shovel-packing for tamping increases the output, which is especially noticeable after the second time on those parts of the line that have already been treated.

The R. A. T. P. (Paris) considers that the introduction of measured shovel-packing on its suburban line makes it possible to increase the time between overhauls.

The General Local Railways Company has been able to reduce the permanent way maintenance staff by 19 %, thanks to the use of chemical weedkilling, and the total cost of this operation was 50 % less than the cost of weeding by pickaxe. They estimate that the output, in the case of the integral overhaul, is 8 m (8.75 yds.), and in the case of the limited overhaul, 16 m (17.5 yds.) of line per men per 8-hour working day.

The Tunisian Railways state that the rational organisation of the maintenance work, which is only made possible by grouping the gangs together, makes it possible to increase the output, in addition

to the 5 to 15 % already mentioned under paragraph (*a*), by about 20 %, owing to doing away with time wasted and unprofitable work.

As an example, the average output obtained per man per 8-hour working day, in 1945 and 1949, were as follows :

	General overhaul	Limited overhaul
Year 1945	4.07 m	9.75 m
Year 1949	4.87 m	16.18 m
Increase in 1949, compared with 1945 . .	19.6 %	65. 9 %

This Company points out that this output would be appreciably increased if the sleepers, most of which are indigenous wood and not impregnated, were of better quality, which would save a great deal of work in strengthening the fastenings.

The Table in Appendix II gives the standard outputs expected from the gangs; these outputs which were by far not achieved two years ago, are now often exceeded.

c) *Owing to the use of mechanical equipment*, a further increase in output is obtained, as the following examples show :

The General Light Railway Company (France) found that the use of a power-driven coachscrew spanner makes it possible to save about 40 % of the hours devoted to the general overhaul of the fastenings (i. e. if 470 hours are required to do all these operations by hand on 1 km of line, 280 hours will be sufficient when a power-driven coachscrew spanner is used).

As mentioned under paragraph 40, the Departmental Railways and North of Milan Railways consider that a power-driven coachscrew spanner makes it possible to save one man in 6 approximately, i. e. 17 %.

The North-Eastern Secondary Railways state that the organisation of long-distance gangs equipped with trucks combined with the use of power-driven coachscrew spanners and adzers, has resulted in increasing the output of the general overhaul by 40 %, and that the average time taken to replace a sleeper has fallen from 60 to 41 minutes.

The Tunisian Railways mention (see paragraph 40) that power-driven coachscrew spanners and drills give a saving over hand operations, considered by themselves, of 750 % to 2 000 % respectively.

The Franco-Ethiopian Railways expects both economical and technical advantages from the use of the Scheuckzer tamper.

54. *Improvements obtained from the social point of view.*

a) Owing to the modification in the constitution of the gangs, if the men usually have to travel further in the case of the large gangs than in the case of the small, most of the Administrations agree that the use of trucks and trolleys or lorries decreases fatigues and reduces the amount of handling. These collective means of transport also shelter the staff from the weather while they are moving about. In addition, the gang can sometimes take a tent with them, which they set up close to the place of work, to act as a shelter.

The grouping of the staff is of particular interest when the railway runs through sparsely populated districts. In this way, the Tunisian Railways have been able to do away with isolated posts, and this has resulted in the following advantages for the staff :

— shopping and travelling facilities;
— possibility of sending children to school near home:
— availability of a doctor.

This Company concludes that from the social point of view, such grouping is essential.

On the other hand, on certain railways, grouping the staff at the section headquarters has the drawback of decreasing the number of men whose wives can act as station masters or crossing keepers, thus enabling them to be housed in railway property.

b) *Owing to the application of the new methods, the working conditions are improved.* The increased output is obtained, not at the expense of the men, but by doing away with wasted time and useless movements, and by using more suitable tools and plant. In particular, shovel packing and gravel packing, when replacing sleepers, have done away with the fatiguing labour of tamping, whilst chemical weedkilling has replaced hand cleaning by pickaxe.

The fact that the work is more interesting and attractive is another advantage, just as much as the diminution of fatigue. The ganger, who has to have professional skill, is no longer considered as a mere labourer, he takes an interest in adapting himself to the new methods, and soon gets into the habit of greater precision in his work. Measured shovel packing is welcomed everywhere, not only on account of the decrease in fatigue already mentioned, but because of the interest of taking measurements by the dansometer, taking observations by telescope, measuring the shovelfuls, etc....

c) *Owing to the mechanisation of the work*, the fatigue of the men is still further reduced, and when power-driven tools are used, their interest in the work is considerably increased. In addition, the faster rhythm of the work, gives them the satisfaction of seeing, at the end of the day, a longer stretch covered by the gang, and under better conditions.

However, to avoid disappointment from the use of these machines, it is necessary to have workmen capable of carrying out their current maintenance with care.

This difficulty of recruiting a sufficiently specialised labour — added to the drawback of being able to dispense with part of the staff which would aggravate the depopulation of the region — has led to the Sardinian Railways giving up using the new methods.

55. *Arrangements under consideration to make further improvements in modern maintenance methods.*

The present tendency is to follow up these methods and develop them on those Railways where they have only been the object of trials, and to introduce them on certain others. However, for several Railways, this modernisation is hampered by the lack of financial means available for the acquisition of the equipment. On other Railways (in particular the Rhaetian Railway and the Viège-Zermatt Railway,) geographical conditions (climate and mountainous nature) hinder new modifications to the present organisation; as a matter of fact, very varied operations have to be carried out, on these lines, during the summer months (drainage, damming rivers, re-ballasting, construction of defences against avalanches, new installations, etc.), so that the organisation cannot be based essentially on a saving in the maintenance costs. In addition, in the case of mechanical equipment in particular, it is necessary to provide for them with a certain caution, as the profit to be expected from them depends on the composition of the gangs and the carefully studied organisation of the work, as well as the period of effective use of these machines (limited, in particular, by climatic conditions, as pointed out by the Rhaetian Railway).

In the case of the R. A. T. P., the problem of the mechanisation of maintenance work on its urban system (Paris Metro) comes up against very special conditions (traction-current voltage, operating methods leaving only a few clear hours during the night, difficulty of getting materials and equipment to the working sites, and of getting from one line to another, tightness of the structure gauge). Investigations are, however, being made to improve the maintenance methods, taking these difficulties into account.

Amongst the new arrangements under consideration, in order to improve the methods, several Railways have given the following details :

The Tunisian Railways are trying out the organisation of large gangs, which they expect to make general, by grouping the local gangs together in pairs, with the following characteristics :

Number of men : 37.

Method of transport : an 80 HP truck which can haul 50 tons.

Mechanical equipment : 2 coachscrew spanners and 2 drills.

Work to be done : general overhaul including pulling the rails back into position, replacing all the fishplates by re-stamped fishplates, increasing the number of sleepers by adding 333 per km (536 per mile), lifting the track by an average of 10 cm (4 in.), cleaning caked ballast, and reconditioning the formation.

The total output obtained on a section whereon the work was organised in this way, for trial purposes at the beginning of 1949, was 4.21 m (4.6 yds.) per man per day on a 8 542 m (5.3 miles) long section. To the previous saving in labour of 20 %, this Company expects to add another 10 % thanks to the new improvements being made, and more careful organisation of the work. The number of men per kilometer of line for maintenance purposes which was 0.88 in 1945 will probably be reduced to 0.54 in the near future.

The Gafsa Railways, in addition to trials of shovel packing and consideration of the use of mechanical equipment, are proposing to introduce special devices to protect the permanent way from drifting sand and to remove sand which has accumulated (building of screens, using a plough or suction equipment to throw out the sand on the sides and pick it up mechanically).

RESUME AND SUMMARY.

All the Administrations who make use of up-to-date methods in maintaining the permanent way consider that they have led to an improvement in the work done, in the condition, of the lines, in the output and working conditions of the men, and that they have produced important savings.

1º Grouping the staff into large gangs responsible for long sections, though fairly widespread, is not yet general. These gangs are most often supplied with some collective means of transport. The Administrations who have regrouped their staff in this way are satisfied with the results, when certain conditions are fulfilled : they generally consider that it is a primary necessity if a rational organisation of the maintenance work is to be obtained.

2º Several Administrations try to stimulate the output and improve the quality of the work by paying output premiums to the gangs. Although the introduction of such premiums is relatively too recent to get a just idea of their effectiveness, these Administrations consider that they have given interesting results.

3º Such methods as a general overhaul by cycles, or integral overhaul with limited overhaul, or various variations of these methods, are applied by the great majority of Railways, who have found the results satisfactory.

4º Various satisfactory methods are used for the conservation and strengthening of the track components, in particular :

— restamping the fishplates or inserting packing pieces;
— welding rail joints and building up frogs;
— re-using damaged holes in wood sleepers by inserting bushes and drilling the new holes in these bushes, or by special fittings or wedges;
— conservation of the chairing surfaces by using metal sole plates or wood packings;
— hooping the ends of split sleepers;
— maintaining the gauge on small-radius curves by using wedges, stops, bearing plates, clips or ties.

5º The Railways which correct the level by means of measured shovel packing find they get greater accuracy and better output than by tamping.

6º Correcting the alignment by the versines method with calculation of slueing required, and providing fixed reference pegs in the track, used on many railways, makes it possible to get regular curves without proceeding by trial and error on the site.

7º Chemical weedkilling has replaced hand weeding on most Railways.

8º The checking of the way the maintenance programme is carried out is done by the Railways by means of graphs or records. Some of them use special recording equipment.

9º Several Railways are endeavouring to extend the mechanisation of their maintenance work, in particular by using power-driven coachscrew spanners, drills and adzes, mechanical tampers, etc. The use of such equipment, which is still in the early stages of development, is economical if it can be used sufficiently to cover its cost.

It is desirable that exchanges of opinions between the Administrations make it possible to get further information on the application of these methods and, in particular, on the use of mechanical tools, in order to further the effective study of new improvements.

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APPENDIX I.

Note on the « Driessen » formula used by the Netherlands Railways to determine the number of men in a gang.

To decide the composition of the gangs, the lines are divided up into 5 classes (Table I appended).

To determine these classes, the different sorts of train (steam, electric), the weight of the locomotives and the wagons, and the speed of the trains were taken into account.

Each class is given a coefficient by which the essential length must be multiplied to obtain the equivalent number of metres of track.

In addition, every other work included in the duties of the gang is expressed in metres of track.

Thus all the work of the gang is expressed as a given number of metres of track.

This number is then multiplied by a coefficient depending on the train frequency and another coefficient depending on the quality of the sub-soil.

It is considered that 3 000 metres can be maintained by one man.

The number of men, obtained from the above calculation, is to be increased by one or two to make good the loss of work due to replacing level crossing keepers, etc., by men of the gang. The total gives the final strength of the gang during the summer, the best season for carrying out permanent-way maintenance work.

In winter, the gangs are smaller; their size depends on circumstances; the smallest gangs consist of 4 men,including the ganger.

An example of how this formula operates is appended (Table 2).

TABLE 1. — «

Description
A. *Running tracks.*
1. Single track of normal profile
2. Single track of other profiles
3. First running track in the stations, of normal profile
4. First running track in the stations, of other profiles
5. Second and other running tracks in the stations, of normal profile
6. Second and other running tracks in the stations, of other profiles
B. *Sidings.*
7. Siding tracks on which trains run
8. Shunting tracks, and similar tracks
9. Sidings of little importance
10. Crossovers
C. *Level crossings.*
11. Level crossings with much traffic
12. Level crossings with little traffic
13. Level crossings of field paths
14. Private level crossings
D. *Switches and crossings in running tracks.*
15. Simple switches or diamond crossings in running tracks of normal profile
16. Simple switches or diamond crossings in ruhning track of other profiles
17. Frogs and double switches in running tracks of normal profile
18. Frogs and double switches in running tracks of other profiles
E. *Switches and crossings in sidings.*
19. Simple switches or diamond crossings in tracks mentioned under 7
20. Frogs and double switches in tracks mentioned under 7
21. Simple switches or diamond crossings in tracks mentioned under 8
22. Frogs and double switches in tracks mentioned under 8
23. Simple switches or diamond crossings in tracks mentioned under 9
24. Frogs and double switches in running tracks mentioned under 9
F. *Other objects.*
25. Railings or hedges
26. Number of locomotives in the depot
27. Supplement for the main gang
Classification of lines.
1. Electrified lines
2. Other lines with a system I A track design (P. N. 46 on cast iron chairs)
3. Lines with a system I B track design (P. N. 46 EST system, or on sole plates)
4. Lines with a system II track design (P. N. 38 system, or on sole plates, and other profiles)
5. Tramways
Coefficients for the number of trains.
1. For less than 20 trains
2. For 20 to 39 trains
3. For 40 to 69 trains
4. For 70 to 99 trains
5. For 100 trains or more
Coefficients for the subsoil.
1. For good-quality subsoil (sand and equivalent)
2. For average-quality subsoil
3. For poor-quality subsoil

— **Equivalent quantities.**

Unit	Class of lines 1	2	3	4	5
m	1.4	1.2	1.1	0.9	0.6
»	1.5	1.4	1.2	1.0	0.7
»	1.3	1.2	1.0	0.8	0.5
»	1.4	1.3	1.1	0.9	0.6
»	1.1	1.0	0.8	0.6	0.4
»	1.2	1.1	0.9	0.7	0.5
»	1.1	1.0	0.8	0.6	0.4
»	0.9	0.9	0.8	0.6	0.4
»	0.7	0.7	0.6	0.4	0.3
»	0.3	0.3	0.3	0.3	—
piece	200	180	150	100	80
»	160	150	120	80	60
»	100	90	70	50	40
»	30	30	20	10	10
»	140	130	120	90	70
»	160	150	140	100	80
»	210	190	180	150	100
»	240	220	210	150	120
»	140	130	120	90	70
»	210	190	180	140	100
»	120	120	100	80	60
»	180	180	150	120	90
»	100	100	80	60	40
»	150	150	120	90	60
m	0.05	0.05	0.05	0 .05	0.05
piece	300	300	250	250	200
m	2 000	2 000	2 000	2 000	2 000
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
—	—	—	—	—	—
1.0	—	—	—	—	—
1.1	—	—	—	—	—
1.3	—	—	—	—	—
1.5	—	—	—	—	—
1.6	—	—	—	—	—
	For A. C. D.	—	—	For B. E.	—
—	1.0	—	—	1.0	—
—	1.3	—	—	1.2	—
—	1.6	—	—	1.4	—

TABLE 2. — « **Driessen** » **formula.** — **Examp**

Calcultatio

Description
A. *Running tracks.*
1. Single tracks of normal profiles. . . . .
2. Single tracks of other profiles . . . .
3. First running track in stations, of normal profile. . . . .
4. First running track in stations, of other profiles . . . .
5. Second running track in stations, of normal profile. . . . .
6. Second running track in stations, of other profiles . . . .
Total for A. . .
B. *Sidings.*
7. Siding tracks on which trains run. . . . .
8. Shunting tracks or the likes . . . .
9. Shunting tracks of little importance. . . . .
10. Crossovers . . . .
Total for B. . .
C. *Level crossings.*
11. Level crossings with much traffic . . . .
12. Level crossings with average traffic . . . .
13. Level crossings of field paths . . . .
14. Private level crossings . . . .
Total for C. . .
D. *Points and crossings in running tracks.*
15. Simple switches or diamond crossings in running tracks of normal profile . . . .
16. Simple switches or diamond crossings in running tracks of other profiles. . . . .
17. Frogs and double switches in running tracks of normal profile . . . .
18. Frogs and double switches in running tracks of other profiles. . . . .
Total for D. . .
E. *Points and crossing in sidings.*
19. Simple switches or diamond crossings in tracks mentioned under 7 . . . .
20. Frogs and double switches in tracks mentioned under 7 . . . .
21. Simple switches or diamond crossings in tracks mentioned under 8 . . . .
22. Frogs and double switches in tracks mentioned under 8 . . . .
23. Simple switches or diamond crossings in tracks mentioned under 9 . . . .
24. Frogs and double switches in tracks mentioned under 9 . . . .
Total for E. . .
F. *Other objects.*
25. Railings or hedges. . . . .
26. Number of locomotives in the depot . . . .
27. Supplement for the main gang . . . .
Total for F. . .

Rotterdam division, Leiden district. — Number of men in the gang (7); Classification of the line (1),

The totals (A + C + D) × train coefficient × subsoil coefficient (6.726 + 820 + 5.250) × 1.5 × 1.3

(B + E) × subsoil coefficient (1.2) = (2 603 + 1 450) × 1.2 = ...

Total F . . . .

Strength of the gang without taking into account time spent relieving level crossing keepers (qua

Loss of work due to relieving level crossing keepers (number of hours per fortnight : 104 (*). . . .

(*) Total number of working hours.

ation to determine the number of men in a gang.
lent quantities.

Unit	Quantities	Coefficient	Equivalent quantities
m	—	—	—
»	—	—	—
»	2 134	1.3	2 774
»	—	—	—
»	3 593	1.1	3 952
»	—	—	—
			6 726
m	1 124	1.1	1 236
»	752	0.9	677
»	985	0.7	690
»	—	—	—
			2 603
pieces	3	200	600
»	1	160	160
»	—	—	—
»	2	30	60
			820
pieces	36	140	5 040
»	—	—	—
»	1	210	210
»	—	—	—
			5 250
pieces	3	140	420
»	3	210	630
»	1	120	120
»	1	180	180
»	1	100	100
»	—	—	—
			1 450
m	1 294	0.05	65
pieces	—	—	—
m	2 000	—	2 000
			2 065

icient (1.5); Subsoil coefficient (1.3).

. . . .	24 952 men
. . . .	4 864 »
. . . .	2 065 »
Together. . .	31 881 »
valent to 3 000 m per man).	10.63 men
. . . .	1.23 »
Together	11.86 men
In round figures.	12 — »

APPENDIX II

Output per man per day on permanent way maintenance as determined by the Tunisian Railways Company.
(Averages recorded during the 3 series of courses for gang foremen, from the 6th January to 21st June, 1947.)

Description of work		Average output per man per day	Maximun output obtained
Tightening up coachscrews, 4 per sleeper, 1 333 sleepers per km (2 145 per mile)		250 to 300 m (273 to 328 yds)	360 (393 y
Tightening up coachscrews, 6 per sleeper, 2 145 sleepers per mile		200 m (219 yds)	
Tightening up sleeper clip bolts including replacement of broken washers, 2 % maximum		400 to 450 m (438 to 492 yds)	467 (511 y
Tightening up fishplate bolts, not including replacing any parts		250 fishplates	300
Inspecting the fishplates, including taking them down completely, replacing small details, and greasing the fishing surfaces (30, 36 and 38 kg = 60.5, 72.6 and 76.6 (lbs. per yd rails) after preliminary oiling		13 to 14 fishplates	15
Levelling by tamping raising less than 3 cm (1 3/16 in.) Number of sleepers tamped	S. G.	30 sleepers	
	N. G.	38 sleepers	
Levelling by tamping, raising more than 8 cm (3 1/8 in.) and less than 10 cm (3 15/16 in.) number of sleepers tamped	S. G.	23 sleepers	
	N. G.	30 sleepers	
Replacing sleepers by gravel packing (small chips)	S. G.	8 sleepers	
	N. G.	10 sleepers	11.2 sleep
Replacing sleepers by tamping without lifting	S. G.	3 to 4 sleepers	4 sleepe
	N. G.	4 to 5 sleepers	
Correcting the alignment by crowbar on track with 30, 36 and 38 kg rails	S. G.	300 to 400 m (328 to 438 yds.)	
Correcting the alignment by crowbar on track with 30 and 36 kg rails N. G.	Wood	500 to 800 m (546 to 875 yds.)	
	Metal	400 to 700 m (438 to 765 yds.)	
Remaking the pathway (berm)		75 to 100 m (82 to 109 yds.)	
Summary correction of the pathway (berm)		140 to 170 m (153 to 176 yds.)	
Continuous levelling by measured shovel packing, excluding the measuring		25 to 30 m (22 to 33 yds.)	36 m (39.4

APPENDIX II *(continued)*.

Description of work	Average output per man per day	Maximum output obtained
Shovel packing : 1 ganger, 14 m (15.3 yds.) an hour.		
Removing ballast : 1 ganger, 14 m (15.3 yds.) an hour.		
Spreading ballast : 1 ganger, 15 m (16.4 yds). an hour.		
Correcting alignment : 1 ganger, 70 m (76.5 yds.) an hour.		
Measurements (readings, dansometers and distribution	150 to 175 m. (164 to 191 yds.)	250 m (273 yds.)
Correction of the gauge (measurements, removing coachscrews, moving the rails, putting back the coachscrews, etc.) excluding recutting the shoulders and strengthening the fastenings. Number of sleepers taken up	65 to 70 sleepers	
Tightening up the fastenings: Replacing coachscrews	100 to 120 pieces	
Tightening up the fastenings: Using A. S. fittings	70 to 80 pieces	
Tightening up the fastenings: Using pegs in worn holes	45 to 50 pieces	
Tightening up the fastenings: Drilling another hole.	45 to 50 pieces	
Tightening up the fastenings: Replacing a fishplate bolt or washer	45 to 50 pieces	
Cleaning and tarring sleepers in the track	100 to 150 sleepers	
Fitting Remy cleats	300 to 350 pieces	
Recutting the shoulders, including tarring	150 to 180 shoulders	
Replacing and respacing sleepers at the same time	35 to 40 sleepers	
Squaring sleepers that are out of perpendicular.	100 to 150 sleepers	

[625 .2]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

15th. SESSION (ROME, 1950).

QUESTION IV.

The comfort of passengers in coaches, railcars and electric motor coaches :

Sound proofing;
Lighting;
Heating, air conditioning, ventilation, thermic isolation;
Upholstery;
Running stability (type of bogie and suspension).

REPORT

(Belgium and Colony, Denmark, France and Colonies, Luxemburg, Norway, Netherlands and Colonies, Poland, Switzerland and Syria)

by O. G. WEBERG,

Ingénieur en Chef à la Direction Générale des Chemins de fer de l'État danois

FOREWORD.

Because of limitations of space, it has been necessary to omit detailed information on some vehicles, particulars of which are given in the report, and to confine the report to vehicles built within the last 25 years, and those under construction or design in most of the nine countries mentioned above, which have been allocated to us.

In this report we have used information supplied in response to a detailed questionnaire submitted to 48 Administrations by the Association.

Of these, 27 have replied, amongst them being the Luxemburg and Tunisian Railways who have associated themselves with the information supplied by the French National Railways; several have no modern rolling stock and in some cases replies have been received too late for use, either wholly or partly, in the report.

Fifteen Administrations have supplied information incorporated in the report and these, with the abbreviations used for them, are listed below :

Belgium and Colony.

Belgian National Railways : S.N.C.B.
Belgian National Light Railways : S.N.C.V.

Denmark.

Danish State Railways : D.S.B.

France, Algeria, Tunisia, Colonies and Protectorates.

French National Railways : S.N.C.F.
French Light Railways : S.G.C.E.
Paris Metropolitan Railways : R.A.T.P.
Algerian Railways : C.F.A.
Gafsa Railway : C.F.G.
Moroccan Railways : C.F.M.
State Railways of Indo-China : C.F.I.

Norway.

Norwegian State Railways : N.S.B.

Holland and Colonies.

Netherlands State Railways : N.S.

Switzerland.

Swiss Federal Railways : C.F.F.
Rhaetian Railway : C.F.R.
Emmenthal - Burgdorf - Thun Railway : E.B.T.B.

For purposes of clarity, it has been considered desirable to divide our report into five main sections :

A. — Sound insulation.
B. — Lighting.
C. — Heating, etc.
D. — Upholstery.
E. — Running stability.

Each section has been subdivided into three Chapters, as follows :

I. Carriages.
II. Railcars or rakes driven by internal combustion.
III. Rail motor coaches or rakes driven by electricty, from overhead line or third rail.

Owing to the short time available, for greater clarity and to shorten the report, we have made extensive use of diagrams and photographs supplied by the Administrations, and of comparative tables.

A. SOUND INSULATION.

A. 1. Methods adopted for preventing noise.

A. 1. — I. Carriages.

The S. N. C. F., on its normal types of stock for haulage, has not taken any special steps designed to reduce running noises. Special precautions have been taken only on the light rolling stock making up the new sets on pneumatic types.

In this case, the wheel has a tyre with an inner air tube of a type similar to that on road haulage vehicles, and is called the « rail pneumatic » by the makers, the Michelin Rubber Co; the tyre is provided with a steel flange. These pneumatic tyres, inflated at a pressure of 9 kg are normally designed to take a load of 1 200 kg (2 645 lbs.) per wheel.

The use of wheels with pneumatic tyres necessitates the use of special devices to allow the short circuiting of lines of rail. These devices consist of rubbing blocks in contact with the rails and arranged to allow the transmission of electric current with a minimum of resistance.

With a view to reducing noise from the wheel on the rail, the C. F. F. has fitted, experimentally, the bogies of a heavy type steel coach with S. A. B. (Svenska Aktiebolaget Bromsregulator) resilient wheels. In this particular case, the bogie is a special one fitted with eight independent wheels. This vehicle has been chosen for the trial on account of the low static load per wheel, which is up to 3 tons loaded, i.e. the maximum permitted figure quoted by the manufacturers of the S. A. B. wheel. It was hoped in this way to obtain an appreciable reduction in the very considerable noise produced by the large number of wheels fitted to this vehicle. As regards noise, the results obtained are not very conclusive, the reduction in noise is relatively small and too little to be appreciated by passengers. Furthermore, at high speeds there is, throughout the coach, a fairly disagreeable feeling of vertical vibration which probably arises from the excentric position taken up by the resilient wheel when under load.

In view of these negative experiences the C. F. F. has not considered it useful to try the S. A. B. resilient wheel on the light coaches which form the subject of this report. The very high price of these wheels

is not in proportion to the small increase in comfort which could be hoped for.

To avoid various noises arising from the brake rigging, plates, etc., most administrations emphasise that it is necessary to avoid, as far as possible, movable parts, to reduce to an absolute minimum the use of flaps and inspection doors, to cover the contact surfaces of sliding parts with wood, rubber, leather or felt and to support the long control rods of the brake rigging by hangers or other supports and to fit rubber to those parts of the control rod which come into contact with the supporting hangers. It is important that the brake rigging should be carefully adjusted at the various joints and have pivots and sockets in special steel.

The N. S. (Netherlands) has, on all modern carriages, arranged the brakework entirely within the bogies, and so removed the principle cause of the creation of noise.

The S. N. C. F. has mounted the electric dynamo on the bogie by means of an axle passing through special rubber rings (Oscillit) and located the carriage lighting booster (rotary motor) on the chassis by means of rubber shock-absorbers.

As steel panels are liable to resonance in the form of drumming, the more so in relation to the stressing in assembly, it is necessary to reduce as much as possible the free surface area by the addition of stretcher bars. In addition, several administrations apply to the interior surfaces of the panels, vibration-damping materials, generally of textile or asbestos base, glued or sprayed, such as the « flock » used by the S. N. C. F. The D. S. B. cover the panels with granulated cork, fixed with varnish.

In order to reduce noise and vibration, the floors of 12 metal coaches of the C.F.M. have been made of oak boards, 25 mm thick, covered with celotex plates, 12 mm thick, a layer of haircloth and of linoleum; these coaches were built in 1933-34.

To obviate creaking, several administrations have fitted strips of flannel under fillets and beadings.

The C. F. F. reports that as a general rule, particular attention is paid to the fixing of gangways and to all fittings which might give rise to noises, but state that these are secondary noises which are generally drowned in the predominant noise of running.

A. 1. — II. Railcars.

The S. N. C. B. has fitted one railcar experimentally with resilient wheels.

The S. N. C. V. uses resilient wheels with rubber buffers. Two types are in use, « S. A. B. » centres and « Carnegie super-resilient » centres for maximum axle loads of 4.25 and 5.5 tons respectively; S. A. B. wheels have cast brake blocks and Carnegie wheels a special brake drum.

Of the original S. N. C. F. coaches, many railcars, the axle loading of which could reach 9 tons, were fitted with movable wheels of specially hard steel with narrow rims (about 15 mm when new). These wheels gave rise, particularly when passing over rail fittings at low speed, to a fairly pronounced ring : this has been very noticeably reduced, by applying to the face of the wheel near the rim, a rubber ring of about 15 mm thickness, held in position by a plate disc, secured by bolts. On the railcars now in service, the width of the rim of the monobloc wheels has been increased from 15 to approximately 25 mm for purposes of longer wear, and this defect no longer exists; the rubber ring has been eliminated.

The Bugatti railcars (80 vehicles) have two four-axled bogies, and are fitted with « deadened » wheels. The amount of resilience in these wheels is small, about 3 mm under the maximum load of 2 400 kg (5 290 lbs.). They provide a small reduction in the amount of noise.

S. A. B. resilient wheels have been tried on the bogies of a railcar with electric transmission (maximum speed 120 km/h. [74 miles/h.] maximum axle load 9.5 tons). The behaviour of the wheels has been satisfactory (mileage about 350 000 km

[217 500 miles]). The reduction in noise is noticeable to the ear, but very small.

With the aim of allowing road vehicles to run on minor lines by the simple substitution of tyred wheels for pneumatic tyred wheels, use has been made of resilient wheels, as in fig. 1 (light alloy centre, two bands of small rubber blocks, not secured and working under shear). These wheels, which have a noticeable degree of flexibility (4 to 5 mm under the maximum load of 3 500 kg [7 716 lbs.]) are satisfactory in service. With the cars so fitted, noise on the rails is comparable to that on the road.

Finally, there is in France a certain number of railcars built by the Michelin Company, fitted with pneumatic tyred wheels.

The C. F. A. has fitted its type Z. Z. R. railcars with wheels mounted on Michelin pneumatics with a wheel loading of 1 200 kg.

The C. F. I. uses resilient wheels or a rubber crown fitted to the face of the monobloc wheel.

The same methods of avoiding noise used on carriages are used on railcars.

The S. N. C. F. has also reduced brake rigging as much as possible (generally having one compressed air cylinder per wheel). The N. S. has fitted bellow gangways over common bogies with an outer covering of woollen felt.

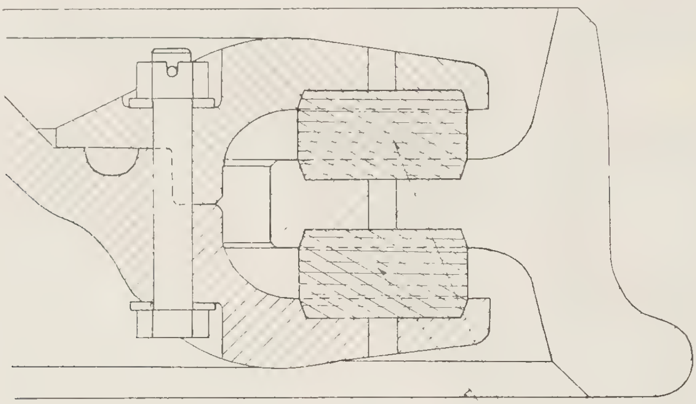

Fig. 1. — Number of resilient blocks : 80 per wheel.

The S. N. C. F. is to carry out tests to endeavour to determine experimentally the reduced stresses obtained by the use of resilient wheels: the use of such wheels should in fact permit reduced dimensions and consequently reductions in the weight of unsuspended parts.

The resilient wheels are provided with stranded copper bonding, providing electrical connections between the centre and the rim, in such a way that the actual electrical resistance of the wheels remains comparable with that of ordinary axles (for track circuiting).

To reduce noise from the thermo-motors of railcars themselves, the S. N. C. V. has used high-speed two-cycle motors (6 cylinders, 160 HP, 1 800 r.p.m.).

On the modern diesel-electric railcars of the D. S. B., each diesel motor and each electric generator is fixed to a common welded pressed steel frame with three point rubber cushioned mounting on the bogie

thus the motors are completely independent of the body.

On the 1943 type motor coaches the exhaust baffles have been specially arranged following trials to secure the minimum of noise.

On the S. N. C. F. air intakes are designed to avoid any whistle and as regards the exhaust the use of silencers has been discontinued as the effect of their removal was unnoticeable to passengers and they increased maintenance difficulties. On recent motors of the S. N. C. F. the exhaust gases are always directed above the body.

The C. F. G. have fixed the diesel motor and the generator rigidly on a welded plate frame and this group frame is fitted to the railcar chassis by resilient shock-absorbers (silent-blocs).

The N. S. have placed the diesel motors in the middle of the motor coach, flanked by the baggage compartments. No special measures have been taken to reduce the noise of the motors themselves, which are equipped with turbo-compressors for supercharging, Buchli type.

To reduce noise from gears of railcars, the S. N. C. B. uses gear boxes and in particular reversing gears with rectified teeth gears. The S.N.C.V. prefers helical gears or better still, reduction bridges with tangential steel screw on a bronze crown. The S. N. C. F. always uses rectilinear gears and rarely uses Gleason gearing. The C. F. A. stresses the importance of eliminating any excess play and emphasises correct lubrication. The N. S. makes use of nose suspension motors and solid gears, and the edges of the teeth of new and replaced gear wheels are completely ground, experience having shewn that noise is reduced by having teeth with ground edges.

A. 1. — III. Motor coaches.

With regard to the S. N. C. F. motor coaches, this Administration has not taken any special steps in its existing stock to reduce running noises, but intends to try out S. A. B. resilient wheels with the aim of reducing fatigue in nose-suspended traction motors, experience gained with such wheels on light type diesel-electric railcars being at present thought insufficient in this respect; this application is capable of reducing running noises. With the aim of reducing the effect of rail shocks on nose-suspended motors, the N. S. B. will soon undertake trials with S. A. B. resilient wheels on two motor coaches with an axle load of 13 tons fully loaded. The electric motors of the N. S. have nose-suspension and flexible gears and like the railcars, the teeth of the gear wheels are fully ground. The S. N. C. F. has mentioned that the gears of motor coaches must be mounted on substantial seatings with robust bearings to avoid undesirable bending or vibration, from the mechanical point of view as well as noise.

Recent designs tend to a form of geared rim which ensures the formation of good oil film by the appropriate relative movement of the teeth. In addition to permitting, all other things equal, the use of cheaper metal in the construction of gears, it may also reduce noise. We consider that this form may dispense with the desire to modify gearing.

The Administration also use on motor coaches the same means as on carriages and railcars for avoiding noise.

A. 2. Means used to subdue the diffusion of noise inside carriages.

A. 2. — I. Carriages.

The S. N. C. B. has not, on its modern rolling stock now in service, made use of rubber seatings, or other material, between the body and the bogie, but carriages now under construction are to be provided with rubber mounted sockets for the lateral bearing blocks on which is carried the entire weight of the coach, and for the centre driving pin.

Several other Administrations use, between the body and pivot, and side bearings, and between the swing bolster and the centre pin socket, side bearings with rubber or felt inserts (N. S. B.).

In the modern trailer vehicles of the S. N. C. F., rubber or other inserts are not used between bogie and body, previous experience having shewn that there is no appreciable improvement.

Armoured rubber inserts have also been tried on Pennsylvania type bogies, between the equalisers and the helical springs but have not been retained for the same reason. On Pennsylvania bogies of vehicles built recently, there is only a wood (oak) packing between the upper buckle of double laminated springs and the swing bolster.

At the same time, a trial is in hand using rubber packing between equaliser and oil axlebox to damp vibration in the equaliser and reduce fatigue.

In the primary suspension of several C. F. F. coaches, helical springs have been mounted between two rubber rings, but this arrangement is intended not only to decrease the diffusion of noise but also to reduce small vertical vibrations.

Supplementary information on these devices will therefore be given in the chapter on smooth running. With regard to transmission of noise a slight improvement is noted which it is not possible to justify by figures.

The S. N. C. B. has fitted the *inner* walls of new vehicles with an insulating material which has acoustic and thermic properties. The material used is glass wool of very fine fibre (6 microns max.) used in 30 mm pads. In existing stock other insulating materials have been applied, sometimes on the inner walls, sometimes on the outer. Where a lot of noise enters by way of holes drilled in the floor for pipes, conduit, cables, etc., attempts are made to cover the holes with plates or packing boxes with felt, etc.

On the modern coaches of the D. S. B., the triple walls of first class compartments have interior surfaces sprayed with flockage. The construction of these walls is shewn in fig. 2. The corrugated metal floor is insulated thermally and acoustically; the corrugations of the upper surface are filled with Expanko cork glued to the metal. The floor has a 10 mm Expanko cork layer, 6.5 mm, Masonite and 3.5 mm linoleum. In the first class compartments the linoleum is replaced by 9.5 mm rubber.

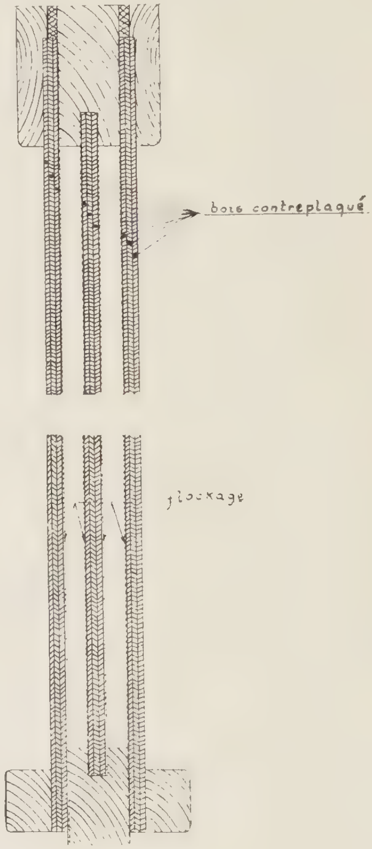

Fig. 2.

Bois contreplaqué = Plywood — Flockage = Flock

In a general way, trials on the S. N. C. F. with insulating materials shew the difficulty of the problem, noise arising particularly in running and penetrating open windows which cannot be systematically closed. Methods used to reduce transmission of noise are :

1) application of antivibration material to walls, compressed or laminated wood, set away from the metal panels and fixed on

wooden brackets with wadding or bitumenous felt pads;

2) flooring of timber (poplar) also laid on timber beams and away from frame-plates;

3) swing doors with false jambs, sliding doors with rubber mounted runners;

4) general « flockage » of all framing and certain fittings (especially plates) liable to vibrate in running.

Certain stock has also had experimental applications of asbestos fibre sprayed on to a bitumen adhesive, to test the advantages of this method of sound-proofing. Other tests have been made, such as sound-proofing of bodies of light vehicles by light layers of synthetic fibre (Isofibre) glued to flock or glass wool mattresses.

On the C. F. A. the floor is insulated as follows :

1st class : cork, linoleum and carpet;
2nd class : cork and rubber flooring;
3rd class : cork and linoleum.

All the N. S. modern vehicles are fitted with acoustic, as well as thermic, insulation (see Chap. C); this insulation consists of an asbestos fibre bedding of about 2 mm positioned : 1) on the interior of outer walls; 2) on the lower surface of the metal floor; 3) inside the roof; 4) between compartment walls; 5) inside end walls; 6) under the streamline longitudinals. The surfaces mentioned are completely covered.

The E. B. T. B. use 20-30 mm asbestos for soundproofing new stock.

A. 2. — II. Railcars.

The same means of reducing propagation of noise used for carriages are also used for railcars.

On the S. N. C. V. the body is carried on strong rubber pads. The steel helical bearing springs have interior rubber buffers.

On several modern railcars, the D. S. B. use rubber in the spring suspension and on the bogie pivots to reduce transmission of noise.

In general, the S. N. C. F. does not at present use rubber insertions between body and bogies. Suspension is on springs only.

The C. F. A. have flexible pivots with rubber blocks on Z. Z. R. and R. Z. Z. R. railcars.

On the C. F. G. rubber sheets have been inset in the swing bolster pivot socket and under the side bolsters. The C. F. I. use thick rubber under the pivot socket and rubber dampers (washers) at the ends of the laminated bogie bearing springs.

The N. S. B. have used rubber between the swing bolster and the pivot socket and between the bogie frame and spring suspension. The N. S. use metallic felt bedding, 8 mm thick between the wooden floor and the longitudinals.

Most motors are mounted on rubber or silent-blocs on the bogie or body-frame as the case may be. Other motors are fixed to the bogie by means of a cradle slung from the frame by three flexible joints.

On the S. N. C. F. combustion engines are usually mounted in the body (this will be the rule on future vehicles) and their auxiliary frame rests on the body frame with heavy rubber shoes, which avoids the transmission of heavy vibrations (particularly when starting or changing gear). The motor suspension can also be ensured, as on our light railcars with high-speed, 150 HP motors, by rubber blocks working under shear.

To avoid transmission by air of the noise of combustion engines, the S. N. C. B. has enclosed the motors by a hood fixed rigidly to the car frame; this hood is made of thin sheets of light metal with an insulating layer.

On the S. N. C. V. the motor casings are sound and heat proofed by sheets and sprayed asbestos with a thickness of about 12 mm.

The D. S. B. use in motor compartments double walls, in certain cases with separate pillars for each wall, and the luggage compartment, vestibule or other compartments are also located between the motor and passenger compartments.

On numerous S. N. C. F. railcars the faces of inner and outer panels and the ceiling

have « flock » applied. Certain motors have insulating mattresses of glass-wool. Other products have had to be abandoned on account of inflammability and their tendency to absorb inflammables.

Recent systematic trials have shewn that products so far used have only a slight effect on the amount of noise in railcars. The entry of noise from outside seems to arise essentially from holes in the floor and sides for piping, cables and various accessories. They can be kept to a minimum, or packed; flaps are avoided as far as possible.

The average level of noise in current railcars (apart from luxury cars) is, during running (at a speed of 100 km/h [62 miles/h.]) in the region of 70 decibels. It has been recognised, in certain railcars under construction, that the floor has some bearing on this question; it is doubled, with ebonite sponge panels, non-inflammable, fixed to the lower part of the chassis members.

On recent railcars, the interior arrangement provides for at least two partition walls between the motor and passenger compartments. The wall nearest the motor is of the « fire screen » type, made up of :

1) an asbestos panel, 2.5 mm thick, with 0.5 mm steel facing in both sides;

2) a free air space 40 mm thick;

3) a 1 mm steel plate.

The doors of the fireproof walls are constructed similarly, they are provided with a double-glass scuttle.

During running, the noise of the motor is barely perceptible in the passenger compartment.

The N. S. B. use, to prevent transmission of noise, a perforated sheet metal floor with felt interlayer, and double walls with sound-damping material between.

A. 2. — III. Rail motor coaches.

In the 1935, 1939 and 1946 types of motor coaches on the S. N. C. B. the sheeting panels (vertical walls and ceilings), have been furnished with 5-10 mm asbestos. Rubber pads have been fitted to the swing bolster and side body bearings of the driving bogies.

On motor coaches being designed for the Paris suburban (S. E. region) service, the S. N. C. F. intends to use a double metal floor with an intermediate glass-wool lagging.

On the two Alsthom - Somua double motor-coaches put into service in 1948, it has been found possible to suppress certain high frequency vibrations from the transmission, and the resulting noise, by using rubber discs (50 mm thick) between the laminated secondary bearing springs and the body.

A similar use of rubber insertion had already been made during the building of 5 motor coaches for feeder services on the Chartres-Le Mans line.

The use of rubber in the suspension has been retained in the design of the suburban motor coaches which will be used on the Paris-Lyons line, in course of electrification.

On the 40 railcars under construction for the R. A. T. P. the bogie pivot will include a rubber cone for transmission of vertical forces and allowing the bogie to rotate by torsion of the cone (new Alsthom device).

All the interior faces of the inside and outside panels as well as the joists and underside of the frame and floor are treated with the « flockage » process (Michel and Marchal, Paris). This process consists in the spraying of wool fibre and an adhesive, thickness 2-3 mm.

This sound proofing is intended more for the prevention of noise in the panelling than to prevent transmission of noise. In fact, so far as stock running in tunnels is concerned, tests have shewn that reverberation from the tunnel walls entered by way of the ventilation openings and the windows.

A large proportion of noise is transmitted by the floor, the construction of which must be greatly complicated if it is to be rendered soundproof.

The N. S. B. use rubber pads between the swing bolster and the pivot socket and

hard wood insertions between the pivot socket and the body. Similar measures are taken with the side bearings on the bogie.

Moreover, several Administrations have adopted or specified similar general arrangements to those used on carriages and railcars.

A. 3. Results of sound insulation.

Measures taken to evaluate the decrease in noise obtained by the arrangements mentioned are not numerous.

In 1942, the S. N. C. B. carried out various tests with a railcar motor, modified with a view to reduction of noise. On this occasion, noises were noted by measuring the current passed by a sealed microphone, both on a test bench and during running. The conclusions drawn from these trials were :

— the modifications to the motor proper (reduction of play in valve stems, alignement of distribution gears worked by the crank, machining of gear-box, clutch plate, etc.) have no noticeable effect on noise;

— the alignment of gears in the gear-box gives appreciable reduction of noise.

On the S. N. C. F. carriages, steps have been taken to determine the degree of noise in the main series of vehicles and to obtain results for comparison, either with carriages or railcars, of the various insulating arrangements (verisol, spray, flock, etc.) or by some particular type of construction or fitment. The first method consists of the use of incident audio-meters having an exciter and vibrator producing a controlled measured noise (masking method).

The results obtained have been small, on the one hand because of the low sensitivity of the apparatus and on the other hand, because of the ineffectiveness of the insulation used. Now, however, tests are made with microphones and valve amplifiers with filters at the time new insulation devices are to be tried. In brief, the problem of sound-proofing coaches, although constantly under investigation, has not so far been satisfactorily solved.

Moreover, the S. N. C. F. has, as indicated above, undertaken comparative trials with new railcars, on delivery from the builders, differing only in the type of material used in the walls and roof. These trials have shown that the influence of the insulating material used was negligible, as regards both sound and heat insulation.

In 1938 the N. S. made a comparative examination of the effect of sound insulation on several vehicles. The difficulty arose that the degree of sound recorded by the instruments (audio-meter, etc.) could not be expressed in absolute values, and the N. S. could thus only indicate the reduction as a percentage, which was 13 % improvement approximately on carriages completely treated with « flock » compared with carriages not treated.

The C. F. F. has not taken any steps to evaluate the reduced noise inside vehicles. The experience in this case was that the degree of sound-proofing obtained could be considered very satisfactory when the doors and windows were closed. Opening of windows in summer completely cancelled, it is stated, the effect of the measures taken to reduce noise.

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B. LIGHTING.

I. Carriages.

Most of the information from Administrations with regard to lighting of carriages is given in Table 1. In general, they prefer batteries automatically charged by dynamos placed in the vehicles or sets, as this system has given complete satisfaction, being simple, effective and well suited to the exigencies of operation and avoiding battery charging and the necessary equipment at stations. The C. F. A., however, uses in its carriages accumulators recharged at fixed points.

The source of energy in modern passenger carriages of the S. N. C. F. is usually

TABLE 1.

Adminis-tration	A. C. or D. C.	Voltage	Frequency	I Incandescent lamps F fluorescent tubes	Source of electricity	Battery
S. N. C. B. (Belgium)	D.C. D.C.	24 72	—	I 1) F 1)	Dynamo, 1.2 or 1.8 kW for incandescent lighting, 2 500 W for fluorescent lighting of international carriages. Drive by flat belt of rubberised material, 110 mm wide, or gears and cardan on international vehicles under construction and future vehicles. The dynamo is located on the bogie. Voltage regulation by Pintsch carbon pile, or Dick, S. E. M., or A. C. E. C. variable resistance.	Standard lead batteries, 240 Ah or 72 V 85 Ah. Th of cadmium nickel or iron n is under consideration.
D. S. B. (Denmark)	D.C.	24	—	I	Dynamo : Pintsch or Dick, 1.5 kW, Rosenberg 1.5 or 2.3 kW. Drive by flat belt or cardan; most dynamos are on the carriage, a few on a bogie.	« Planté » lead batteries 280 Ah. Ironclad batt 180 or 360 Ah.
S. N. C. F. (France)	D.C. D.C. A.C.	24 1) 72 2) 220	— — 80	I I F	Suburban and omnibus coaches, power 2 kW. Main line coaches 6 kW. Dynamos are slung from interior bogie frame between headstocks. Drive by trapezoidal endless belt (4 and 7 driving surfaces respectively) with grooved pulleys in magnesium alloy, keyed to axle and armature. The induction regulator is discharge or carbon pile, so that dynamo supply is 24 to 31 V according to state of battery for 24 V dynamos, or a voltage regulator for limiting lighting supply to 25 V. The 72 V dynamos supply a constant voltage (72 V) for the lighting circuit and a booster provides the necessary tension for battery charging.	In modern trailer ve batteries of cadmium accumulators with straight and high electrolytic capaci used exclusively. Capacities : 1° *For main line vehicles* : *a*) Fitted incandescen 205 Ah; *b*) Fluorescent lamp Ah. 2° *Omnibus and suburban ve* The capacities allow normal discharge peri 5 hours.

. — Carriages.

ss mpt.	Coaches with side corridor: Incandescent lamps: Norm. W	Reading W	Night W	Fluorescent tubes: Normal W / Length mm	Night W	Coaches with centre corridor: Lamps: I W	F W / Length mm	Remarks
	1×40	4×15	—	—	—	—	—	1) Incandescent lamps on all vehicles constructed up to date, fluorescent tubes in international vehicles under construction, and coaches constructed or rebuilt in future. 2) Double filament, 40 W for main lighting, 5 W for night lights. 3) Blue glass lamps. 4) The tubes work on 72 V D. C., power absorbed 25 W.
	1×40	4×15	—	—	—	2×30 or 40	4×14 4) / 360	
	2×25	—	—	—	—	2×25	2×14 4) / 360	
: 2	1×40	4×15	5 2)	3×14 4)	10 3)	—	—	
	2×25	—	10 3)	2×14 4)	10 3)	—	—	
rnal ice	2×25	4×10 1)	—	—	—	2×25	—	1) First class only. In the corridor, 4 or 5 lamps, 15 W; lavatory and vestibules, one 15 W.
tional ice der tr.)	2×40	4×10 1)	8	—	—	—	—	
: 2	2×40	—	10 4)	1×25 3) / 1 000	4)	—	—	1) For omnibus and suburban stock (radiator heaters). 2) For main line stock (forced air heating). 3) 1 500 lumens. 4) In 72 V. DC lighting, night lights are 10 W incandescent lamps, blue glass. AC. fed fluorescent lamp circuits have neon discharge lamps giving a very low yellowish light. Corridors of main line stock are lighted at night, all classes, by 25 W incandescent lamps in a glazed roof mounting, and arranged on the right of the transverse wall axis, towards the longitudinal corridor wall; or by 0.36 m fluorescent tubes, 15 W, 375 lumens, with an opal screen arranged above the cornice of the corridor wall. Lavatories have an incandescent opal lamp or a fluorescent bare tube, 0.36 m, 15 W, mounted above the mirror. Vestibules have either two incandescent lamps in glass fittings or a 1 m 15 W fluorescent tube with opal screen. These are placed centrally on the ceiling. Incandescent lamps in omnibus and suburban stock are roofmounted along the coach centre line to give two bare lamps per bank of seats, 40 W for 2nd class, 25 W, 3rd. class. Naked fluorescent tubes, 1 m long, 25 W are arranged on the roof centre line to give one lamp per bank of seats, this lamp being perpendicular to the benches. Vestibules are lit at night by 25 W Incandenscent lamps, naked 25 W, or a naked fluorescent tube, 1 m, 25 W.
	2×25	—	10 4)					
	2×40	-	—	1×25 3) / 1 000	4)	—	—	
	2×25	—	—	—		—	—	

Adminis-tration	A. C. or D. C.	Voltage	Frequency	I = Incandescent lamps F = fluorescent tubes	Source of electricity	Battery
C. F. A. (Algeria)	D.C.	24/30	—	I	E. V. R. dynamo, type A. 2. 25 kW.	Type 538, T. VII, S. A. capacity 240 Ah.
C. F. M. (Marocco)	D. C.	48	—	I	Brown-Boveri generator, 2 kW, fixed under the frame, driven by belt from axle pulley.	Cadmium nickel, 38 elem 136 Ah, recharged by dy whilst running.
C. F. I. (Indo-China)	D.C.	24/30	—	I	E. V. R. dynamo, type B, 1.5 kW, belt drive, mercury regulator.	Double batteries, 2 × 36 units of cadmium n about 3 000 W.
N. S. B. (Norway)	D.C. A.C.	32 12	— 16 2/3	I I	D. C. shunt dynamos, 40—80 A at 4—800 r. p. m. Spring belt or cardan and conical gear oil bath drive. Automatic tension regulation and charging on all vehicles. A. C. supply taken from overhead conductor.	Alkaline accumulator, 2 ments of 300 Ah or lead, 1 ments 200 Ah.
N. S. (Netherland)	D.C. A.C.	24 110	— 400	I F	Dynamo capacity : 24 V, 100 A. Amperage depends on speed and state of battery. Cardan drive. Dynamo placed at side of bogie. Automatic constant tension regulator. Rotary converter, fed at 24 V, 1 000 W, gives 110 V, 400 cycles current.	Alkaline, 19 cell, giving 300 Ah.
C. F. F. (Switzerland)	D.C.	36	—	I	4-pole dynamo, shunt excitation, nominal tension 36 V, max. 45 V, hourly rating 2.2 kW. Drive by conical gear from axlebox by cardan shaft. Dynamo on bogie frame (fig. 3). B. B. C. automatic regulator.	Lead, nine elements, 90 Ah . Each carriage ha batteries in series.
C. F. R. (Switzerland)	D.C.	36	—	I	1.4 kW dynamo with cardan shaft, placed in coach. B. B. C. type regulator.	Lead, 60 Ah. Automat charge.
E. B. T. B. (Switzerland)	D.C.	36	—	I		Nife, Edison and lead. 9

. — **Carriages** *(Continued)*.

ass mpt.	Coaches with side corridor					Coaches with centre corridor		Remarks
	Incandescent lamps			Fluorescent tubes		Lamps		
	Norm. W	Reading W	Night W	Normal W Length mm	Night W	I W	F W Length mm	
	2×25	—	1 × 2	—	—	—	—	Corridor, lavatory and vestibules: 25 W.
1	4×17	—	1)	—	—	—	—	1) No special night lights; intensity reduced by insertion of a resistance.
2	2×17	—	—	—	—	—	—	
& 2	2×25	—	—	—	—	—		1) In semi-sleepers.
3	1×25	— 1)	6	—	—	—	—	
	25 or 40	16	1)	—	—	—	—	1) In new sleepers only.
& 2	—	—	—	4×25	1×15 1)	—	—	1) One lamp with blue glass protector per compartment.
	—	—	—	3×25	1×15 1)	—	—	
	4×40	—	25 1)	—	—		—	1) Corridors, lavatories and vestibules: 15 W. Dark blue glass cover.
	2×40	—	25 1)	—	—	2×40	—	
	2×25	—	—	—	—	2×25	—	
	2×60	—	25	—	—	—	—	Lamp voltage 18 V. In each lavatory one 25 W lamp.
	3×40	—	—	—	—	—	—	
	—	—	—	—	—	—	—	Lavatories and vestibules: 15 W.
	—	—	—	—	—	—	—	

an alkaline battery automatically recharged by a dynamo generator driven from the axle, but in certain fixed suburban sets with steam locomotives specially designed for this service, the current required for the lighting is provided by a turbo-generator (6 kW, 110 V) on the engine, without there being any accumulators on the carriages or locomotive.

In pneumatic-tyred sets, the electric light current is furnished directly by a generator group. At the same time, there are accumulators on the carriages, but they do not supply lighting (emergency lighting) except in the event of failure of the normal supply. Electricity for lighting and supplementary fittings is also supplied from a central source, comprising a generator group mounted in the rear brake.

Characteristics : driving motor, 40 HP at 2 400 r.p.m.; generator, A. C. 3-phase, 220-380 V, 80 cycles, 25 kVA at 2 400 r.p.m.

Emergency candle lights are provided in all international vehicles by most Administrations. In special vehicles mounted on pneumatic tyres, with a Diesel generator lighting set, the S. N. C. F. provides emergency night lighting by incandescent electric lamps supplied from an accumulator battery in each coach. This battery, of low capacity, is recharged during running by a charger comprising a transformer and rectifier with manual control of tension. Each C. F. A. coach has a 25 m flexible cable for connection to the next coach. On the N. S. emergency lighting comprises 8 25 W lamps per coach; the lamps are arranged along the corridor. In addition, two couplings for R. I. C. emergency lighting mobile apparatus — R. I. C. plate 21 — are provided in each compartment and in the corridor.

Fig. 3 — Lighting dynamo mounted on SWS bogie.

The lamps are roof-mounted. To avoid the filaments being directly visible to the eye, most Administrations have pearl or opal lamps, or clear lamps with pearl or opal diffusers. Fluorescent tubes are in some cases mounted with a translucent plastic screen. In centre corridor coaches the lamps are normally arranged in two parallel rows.

With regard to fluorescent tubes, the S. N. C. F. states that modern coaches have so far been fitted with incandescent lamps, but they will in future have fluorescent

tubes, whether for main line, omnibus or suburban services.

The S. N. C. F. now has 18 pneumatic-tyred vehicles and some 20 carriages of various kinds fitted experimentally with fluorescent lighting.

Coaches now leaving the builders have not been designed for fluorescent lighting, but the electrical equipment (booster) has been modified so the present incandescent lamps may be replaced by fluorescent lights without major adjustment.

To shew that the use of fluorescent lighting is more than an unconfirmed tendency on modern stock, the S. N. C. F. states that 100 C10 coaches on order for main lines will have fluorescent lighting throughout.

In most separate compartments, particularly in international coaches, passengers have a switch for cutting off normal lighting, or for switching on in the evening; switches are also provided for reading lights.

Otherwise, particularly in the case of centre corridor coaches, lights are controlled by the train staff.

Most Administrations protect the lamps against impact and removal by diffusers or covers only, but special sleeves and lamps marked with the name of the Administration are also used. The C. F. I. (Indo-China) protects lamps in the 4th class by a grill.

Some Administrations have measured light intensity in vehicles of modern design, with the following results :

S. N. C. B.

Class.	Type	Light in lux.		
		average	maximum	minimum
	Centre Corridor.			
2.	2 40 W incandescent lamps	34.5	46	24
3.	2 25 W — do — do —	26	32.7	17
2.	4 14 W fluorescent tubes	179	260	123
3.	2 14 W — do — do —	81	99	61
	Side Corridor.			
2.	1 lamp 40 W, plus 4 reading lamps of 15 W . . .	32	59	17
3.	3 14 W fluorescent tubes	110	130	82

A minimum of 40 lux at reading level is specified for all classes.

Danish State Railways.

The U. I. C. regulations are followed for international coaches under construction.

Belgian National Railways.

At reading level, 1 m above floor :

1. *Incandescent lighting,* 20 to 45 lux.

2. *Fluorescent lighting of main line coaches,* 60-120 lux.

Illumination of 60-90 lux at reading level is specified.

Norvegian State Railways.

Lighting of new vehicles, as for fast trains, is measured at 60-70 lux above the table or at reading level. U. I. C. regulations are adhered to.

TABLE II. — B.

Adminis-tration	D. C. or A. C.	Voltage V	Frequency	I Incandescent lamps F fluorescent tubes	Source of electricity	Battery
S. N. C. B. (Belgium)	D.C. D.C. D.C.	24 1) 72 2) 96 4)	— — —	I I 3) I	Type of railcar — / Power of dynamo — / Type of regulator — Single, light, 2-axle . . . . 500 W Scintilla Single, light, bogie . . . . 1 000 W Scintilla Single, mechanical . . . . . 500 W Bosch Single, mechanical . . . . . 1 250 W Bosch Single, mechanical . . . . . 2 500 W Scintilla Double, mechanical . . . . 2 500 W E. V. R. Single, electrical . . . . . . 2 400 W Dick Double, electrical . . . . . 3 600 W Dick Triple, electrical . . . . . . 11 000 W Dick Triple, electrical . . . . . . 11 000 W Pintsch Triple, hydraulic . . . . . . 6 000 W Dick Dynamos driven by motors, through belt or gears.	Lead type batteries, with t following characteristics: Type of railcar — / Cap. Ah — / Volt — Light, 2-axle . . . . 120 24 Light, bogie . . . . 260 24 Heavy, mehanical 384 24 Heavy, electric or hydraulic transmission 240 96
S. N. C. V. (Belgium)	D.C.	24	—	I or F	The 24 V tension is provided by a battery charged automatically on the vehicle. Power of dynamo, 900 to 1 500 W.	Lead alkaline battery on tr (also used for starting) 250 . for 10 hours.
D. S. B. (Denmark)	D.C.	65	—	I	Dynamos driven by the motors. Tension varies with speed, but lighting tension controlled by converter (rotary) and B. B. C. automatic regulator.	Ironclad lead, 250 Ah (al used for starting).
S. N. C. F. (France)	D.C. D.C. D.C.	24 72 1) 120 2)	— — —	I I I	On railcars with mechanical transmission the charging generators are always driven by the motors (mostly by direct drive, occasionally by belt). Dynamos generally 1 800 W. On cars with electric transmission the auxiliary generator usually charges. On bogie trailers, generator is belt driven from axle. Generator output 2 000 W, 24 V. Light trailers, 2-axle, have no source of energy, lighting circuits are fed by railcar generator and battery. All generators have automatic voltage and output regulators arranged in separate box.	S. N. C. F. use alkaline accu lators exclusively, of follow capacities : Lighting and starting : — 300 Ah, 410 Ah, 318 Ah, elements. 75 Ah, 150 Ah, 56 eleme Lighting : 215 Ah, 19 elemen

ting. — Rail motor coaches.

Class f compt.	Coaches with side corridor Incandescent lamps Norm. W	 Reading W	 Night W	 Fluorescent tubes Normal W Length mm	 Night W	Coaches with centre corridor Lamps I W	 F W Length mm	Remarks
2	—	—	—	—	—	2×30 or 40	4×14 5) 360	1) For present railcars with mechanical transmission. 2) For new construction. 3) A triplet railcar has been partly fitted with fluorescent tubes. 4) For present railcars with electric or hydraulic transmission. 5) The tubes, 72 V D. C., consumption 25 W.
3	—	—	—	—	—	2×25	2×14 5) 360	
	—	—	—	—	—	14×40 1)	6×40	1) There is only one compartment.
	2×25	4×10 1)	—	—	—	2×25	—	1) First class only. In corridors, 3 or 4 15 W lamps. Lavatory, one 15 W and in each vestibule two 15 or 25 W.
	—	—	—	—	—	2×25 or 40	—	1) Normal tension. 2) Used on some railcars with electric transmission.

TABLE II. -

Adminis-tration	D. C. or A. C.	Voltage V	Frequency	I — Incandescent lamps F — fluorescent tubes	Source of electricity	Battery
S. G. C. E. (France)	D.C.	24	—	I	24 V. Dynamo, 1 000 W located by the motor, belt drive.	Lead, completely rechar by dynamo.
C. F. A. (Algeria)	D.C.	24	—	I	Scintilla dynamo and regulator.	S. A. F. T. 200 Ah.
C. F. G. (Tunisia)	D.C.	72	—	I	Charging dynamo, Paris-Rhône type G. E. 10 C. 70/90 V, 1 500 W. driven by Diesel motor and three trapezodial belts. Voltage and output regulators on shunt excitation of dynamo by in/out resistances.	S. A. F. T. cadmium nickel ty 11 Y N 11, 72/90 V, 100 Ah
C. F. I. (Indo-China)	D.C.	24	—	I	Scintilla of E. V. R. dynamo, 1 500 W. geared drive. Discharge regulator with make and break.	S. A. F. T. type 13 GN 410 Ah, 18 cadmium ni elements.
N. S. B. (Norway)	D.C. D.C. D.C.	12 24 110	— — —	I I I	Dynamo powers vary on different vehicles between 0.3 and 12 kW. In general, dynamo driven by the motor, but also by gear box by cardan shaft or grooved pulley and belt. Automatic regulator.	Lead or alkaline accumulat 200—300 Ah.
N. S. (Netherlands)	D.C.	100	—	I	The auxiliary dynamos for battery charging are mounted on the traction generator shaft, coupled direct to Diesel motor. Auxiliary dynamo capacity 150 V, 170 A. Amperage depends on state of battery. Automatic constant tension regulator. Each Diesel electric group, three per motor vehicle, has an auxiliary dynamo.	Alkaline type, 90 cells, 145 300 Ah. Battery also used starting Diesel motor.

. — **Railcars** *(Continued)*.

ss mpt.	Coaches with side corridor					Coaches with centre corridor		Remarks
	Incandescent lamps			Fluorescent tubes		Lamps		
	Norm. W	Reading W	Night W	Normal W Length mm	Night W	I W	F W Length mm	
–	—	—	—	—	—	—	—	1) Lamps are in eight roof fittings.
–	2×25	—	—	—	—	—	—	Corridor, lavatory and vestibule, 25 W.
& 2 3	4×10 1) 6×25 2)	— —	— —	— —	— —	— —	— —	1) Two parallel rows of 2 lamps. 2) Two parallel rows of 3 lamps.
–	—	—	—	—	—	12×25		Lavatory 16 W.
3	—	—	—	—	—	25	—	
& 2 3	2×40 2×25	— —	1×15 1) 1×15 1)	— —	— —	— —	— —	1) One 110 V lamp, blue glass, in separate compartments only.

Netherlands Railways.

In a model 2nd class compartment, lighted by four 25 W fluorescent tubes, the intensity at 1 m level above the floor is measured at 185-215 lux. The standard specified at reading level is 100 lux.

Swiss Federal Railways.

1st class : 60-80 lux;
2nd class : 45-55 lux;
3rd class : 32-40 lux.

Measurements were taken in accordance with § 32/No. 2 of the R. I. C. (1st October, 1938 edition).

There are no special rules covering light intensity at reading level. Arrangement and power of lamps have been designed to provide satisfactory lighting in all compartments.

II. Railcars.

Information from Administrations with regard to railcars is summarised in Table II.

As with carriages, Administrations prefer batteries automatically recharged on the vehicle (or set).

As regards the D. S. B. « flash » trains, lighting of trailer vehicles is by electricity produced by the railcar motors.

On S. N. C. F. lines, the principle followed is to use individual lighting, except for light 4-wheeled trailers, for which the cost of an individual equipment appears too high; in addition, the power required for small vehicles can easily be supplied by the railcar equipment.

The Netherlands Railways use three auxiliary dynamos per quintuple set. On S. N. C. V. cars, emergency lighting is connected to the battery.

On S. N. C. F. lines, passenger compartments are provided with fittings for obtaining the emergency candle lights available at stations. In practice the need for this emergency lighting is not felt with railcars, as the batteries required for the motor are of large dimensions.

The Norwegian State Railways also provide for emergency candle lighting, whilst on the Gafsa Railways, the conductor has two acetylene lamps for emergency use.

The general remarks on the arrangement and types of lamps, and on their protection, in carriages apply also to railcars.

In railcars, passenger-operated switches are provided only in isolated cases of separate compartments.

Some Administrations have measured light intensity concerning their railcars with the following results :

Belgian National Railways.

Class.	Type of lighting	Lighting in lux		
		average	maximum	minimum
2.	2 40 W incandescent lamps	34.5	46	24
3.	2 25 W incandescent lamps	26	32.7	17
2.	4 14 W fluorescent tubes	179	260	123
3.	2 14 W fluorescent tubes	81	99	61

The specified minimum for all classes is 40 lux at reading level.

S. N. C. V. (Belgium).

Lighting at the reading level is 40 lux with incandescent lamps and 75 lux with fluorescent lamps.

S. N. C. F.

Seated passengers have a lighting of 40-50 lux at normal reading height (hor-

zontal plane 0.90 m [3′] above the floor).

It is considered that a level of 50 lux is suitable for vehicles in ordinary services and 60-90 is desirable for long distance services.

Norwegian State Railways.

A light intensity of 40-50 lux is provided.

Netherlands Railways.

A second-class compartment with two incandescent 40 W lamps has a light intensity of 40-60 lux at 1 m above the floor, and a third-class compartment with 2 25 W lamps, 25-40 lux.

III. Rail motor coaches.

In the case where normal lighting is provided by batteries, recharging is automatically done on the vehicle.

The S. N. C. F. has experimentally equipped two motor coaches with motor groups (600 V D. C.), alternators (A. C. 110 V, 50 cycles); these groups are designed to supply normal fluorescent tubes, hot cathode type.

Certain suburban coaches of the S.N.C.F. have a converter group fed directly from line tension and without accumulators.

The S. N. C. B. 1935 motor coaches have one equipment for the driving coach and one for the trailer. Double coaches have a single equipment serving two coaches.

On the D. S. B. a two-vehicle set has a common converter.

On the S. N. C. F. the source of energy on a motor coach always provides all the energy required for the trailers normally used with it. The arrangement is adopted because of its simplicity, the existence of a source of energy being integral in the motor coach.

On the N. S. two rotary converters (1 500 V/100 V D. C.) are used per quadruple set and one per double set.

Vehicles fitted with emergency lighting are supplied with a battery; the N. S. B. uses candles.

The general remarks on the arrangement and types of lamps in carriages and railcars apply also to the motor coaches. Lighting in motor coaches is controlled exclusively by the train staff.

Rail motor coaches at present being designed by the S. N. C. F. will have lamps wired in series on direct line tension, and compulsorily enclosed in a roof mounting. The lighted surface will be of obscured glass.

Light intensity measurements quoted for railcars apply also to motor coaches.

Most of the information from Administrations relating to lighting of motor coaches is collected in Table III.

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C. HEATING, VENTILATION, AIR CONDITIONING, HEAT INSULATION.

C. 1. Steam heating.

C. 1. — I. Carriages.

The S. N. C. B. uses Westinghouse improved heating. Pressure in the piping is 5 kg/cm² (71 lbs. per sq. inch.).

The D. S. B. uses Pintsch steam heating. Pressure in the piping is 4 kg/cm² (56 lbs. per sq. inch.). Radiators are placed along the outer corridor and compartment walls and under the seats.

The S. N. C. F. uses forced air heating, with air heater working on steam expanded from a pressure of 0.5 kg/cm² (7 lbs. per sq. inch.); the steam pressure at the locomotive is 4 to 6 kg/cm² (56 lbs. to 85 lbs. per sq. inch.) according to outside temperature.

Modern compartment vehicles with forced-air heating have no corridor radiators.

The vestibules only are heated by vertical radiators mounted on the lavatory compartment walls.

Earlier convection heating appliances had radiators fixed to the lower part of the wall.

The C. F. A. uses a steam pressure of from 2 to 5 kg/cm² according to outside temperature and radiators are placed 148 mm above the floor under window lights.

TABLE III.

Adminis-tration	D. C. or A. C.	Voltage	Frequency	I Incandescent lamps F fluorescent tubes	Source of electricity					Battery		
					Type of motor coach	Power of dynamo	Drive	Loc.	Type of regul.	Type of battery	Capacity Ah.	V
S. N. C. B. (Belgium)	D.C.	36 1)	—	I								
		72 2)	—	F								
					1935, motor coach : 1 motor coach at each end, trailers between :							
					a) motor coaches	36-45V-75-A	M	Under frame	Pintsch	Pb	180	
					b) trailers	36-45V-75A	Belt	Bogie	Pintsch	»	180	
					1939, double	36-45V-105A	M	Under frame	Pintsch	»	240	
					1946, double (*)	36-45V-105A	M	Under frame	Pintsch	»	120	
					1950, double	80-50A	M	»	E.V.R.	Cd-Ni	131	
					M = direct drive from 3 000 V motor.							
					(*) Installed at construction, for incandescent lighting.							
S. N. C. V. (Belgium)	D.C.	24 1)	—	I	The 600 V tension is taken from the electric line. 24 V supply is from an accumulator battery automatically recharged on the vehicles. Tests in hand with two motor coaches having motor groups (600V D. C.), alternators (A. C. 110 V, 50 cycles). These groups are designed for fluorescent tubes with heated cathode.					Lead (alkaline on trial) city 120 Ah — 10 hours.		
		600 2)	—	F. 2)								
D. S. B. (Denemark)	D.C.	65	—	I	Rotary converter, fed at 1 500 V, capacity 28 A; current produced by converter also used for drive.					« Planté » for emergency ing, 40 Ah recharged o coach. No battery for n lighting.		

ing. — Rail motor coaches.

lass ompt.	Coaches with side corridor — Incandescent lamps — Norm. W	Reading W	Night W	Fluorescent tubes — Normal W / Length mm	Night W	Coaches with centre corridor — Lamps — I W	F W / Length mm	Remarks
2	—	—	—	—	—	2 × 40 or 2 × 60 1)	4 × 14 / 360 3)2)	1) For 1935 and 1939 types of motor coaches. 2) For 1950 type under construction, and 1946 type. 3) The tubes work on 72 V D. C., consumption is 25 W.
3	—	—	—	—	—	2 × 30 or 2 × 40 1)	2 × 14 / 360 3)2)	
—	—	—	—	—	—	14 × 40	6 × 40 3)	1) For exterior lighting (handlamps, etc.). 2) For interior lighting of new or modernised coaches with fluorescent tubes or older incandescent lighted coaches. 3) The tubes are arranged on the centre line of the body, which has one compartment, in plastic opaline mounting.
—	—	–	—	—	—	2 × 25	—	In each section, 2 × 25 W lamps.

TABLE III

Administration	D. C. or A. C.	Voltage	Frequency	I = Incandescent lamps F = fluorescent tubes	Source of electricity	Battery
S. N. C. F. (France)	D.C. D.C.	24 1) 72 1)	— —	I I	On electric rail coaches with alkaline accumulator batteries as primary lighting source, they are always charged from line tension by spring mounting with auxiliary equipment such as ventilator or compressor motor.	Power varies greatly, accor to traction control equipme cuits, as supply and lightin not main functions.
R. A. T. P. (France)	D.C.	600	—	F	D. C. from live rail, and feeding each motor coach.	Emergency lighting to articulated motor coach battery of cadmium-nickel mulators, 72 V, 20 Ah.
N. S. B. (Norway)	D.C. A.C. 1)	32 12	— 16 2/3	I I	Converters for battery charging on each vehicle, but energy provided by 1 000 V through train wiring. Advantages : no moving parts, little maintenance. Disadvantages : through wiring must remain coupled, even in summer.	Lead or alkaline accumu 2—300 Ah.
N. S. (Netherlands)	D.C.	100	—	I	Accumulators are charged by a rotary converter, fed at line tension (1 500 V), capacity 100 V, 100 A. Automatic constant tension regulator, Converter located under floor.	One battery per double se per quadruple set. Type, line, 70 cells, 100 V, 1C macapacity.
C. F. R. (Switzerland)	D.C.	36	—	I	1 400W dynamo with cardan transmission, mounted under coach body. B. B. C. type regulator.	Lead, 60 Ah recharged tically in the coach.
E. B. T. B. (Switzerland)	D.C.	36	—	I	Fixed installation with dynamo, regulator and batteries; automatically recharged.	« Nife », « Edison » an accumulators, 90 Ah cap

ss mpt.	Coaches with side corridor					Coaches with corridor centre		Remarks
	Incandescent lamps			Fluorescent tubes		Lamps		
	Norm. W	Reading W	Night W	Normal W / Length mm	Night W	I W	F I / Length mm	
-	—	—	—	—		2×25 to 40	—	1) The voltages of batteries used on recent motor coaches are 24 or 72 V, but lighting voltage may be higher when furnished by a motor-generator group (e. g. 100 V, on feeder services, Paris-Le Mans). Suburban coaches being designed for South-East suburban electrification will have 240 V lighting, 6—240 V lamps in series on line voltage.
-	—	—	—	—		25 1)	2)	1) Incandescent lamps for emergency lighting. 2) 60 cm fluorescent tubes (1 200 lumens) for normal lighting, in two longitudinal lines, on every 1.55 m.
-	—	—	—	—		25	—	1) A. C. so far used on a small number of motor coaches, but understood to be replacing D. C.
	2×40 2×25	— —	1×15 1) 1×15 1)	— —		— —	— —	1) One lamp, 110 V blue glass, in separate compartments only.
	2×40 2×25	— —	— —	— —		— —	— —	In vestibules and lavatories : 25 W lamps.
	2×40 2×25	— —	— —	— —		— —	— —	In vestibules and lavatories : 15 W lamps.

On the 12 metal coaches of the C. F. F., uniform heating is effected by Westinghouse thermostatic radiators; steam pressure in long trains is 6 kg/cm².

On the N. S. B. automatic pressure regulation is provided for the heating system, the pressure in the steam piping is 4 kg/cm².

In modern sleeping cars hot air heating is used. The corridors are heated by flexible pipes (Vapor car heating).

The C. F. F. has no steam heating in modern coaches.

None of the Administrations mentioned in this Report uses a condensation water-recovery system.

C. 1. — II. Railcars.

To make it possible for carriages to be used in both steam and railcar sets, the 1943 D. S. B. railcars and those under construction are provided with a boiler and steam heating, Pintsch system. The boiler is oil-fired and works automatically, producing steam for trailers as well (see Chap. C 3).

Before the war, several flash-boilers were tried by the S. N. C. F. for steam heating railcars and trailers (to allow haulage of standard carriages with steam heaters). The boilers have been removed because of their complication, volume and the increased weight, particularly of the reserve water supply required. It has therefore been decided to use with railcars only those coaches with an individual heating system.

C. 1. — III. Rail motor coaches.

Steam heating is not used in rail motor coaches.

C. 2. Electric heating.

C. 2. — I. Carriages.

The S. N. C. B. uses radiators as this is found to be the simplest and most efficient system. The tension used is 3 000 V for coaches working on internal services; 1 000, 1 500 and 3 000 V for international coaches. Internal coaches are fitted with passenger compartment heating of 230 to 300 W/m³.

For international coaches under construction, reconstruction or conversion independent radiant heating has been adopted for each compartment. The minimum power required for these carriages is 34 kW. It should be noted that the international 1st and 2nd class composite coaches have eight compartments of six seats and international 3rd class coaches have 11 compartments of eight seats.

In internal service coaches, 17° to 19° C. has been obtained with — 10° C. outside and in international coaches 19° C. with — 10° C. outside, at 100 km/h. (62 m.p.h.).

The capacity of the accumulators used for electric heating is about 25 W for internal coaches, and about 600 W for international carriages.

The D. S. B. uses electric heating only for international carriages. Tension is 1 000 V for carriages to Norway and Sweden, and 1 000, 1 500 and 3 000 V for other countries. About 35 kW is provided for these coaches. Radiators in compartments are placed below the seats and in corridors and lavatories on the partition walls. Heating is calculated for an outside temperature of — 15° C. and a speed of 120 km/h. (74 m.p.h.).

The heating system used in modern, side corridor and compartment, vehicles of the S. N. C. F. is « forced-air » type with radiators for the vestibules and lavatory water heaters.

It is considered that this provides a satisfactory standard of comfort, in particular it prevents the disagreeable odours which arise from carbonisation of dust accumulating on radiators.

For omnibus and suburban vehicles, electric radiator heating is used in view of the simplicity of its installation in vehicles of this type.

Electric heating installations in internal service vehicles are 1 500 V D. C.; in international vehicles they are: 1 000 V A. C. 16 2/3 cycles; 1 000 V A. C. 50 cycles; 1 500 V D. C. or 3 000 V D. C.

In modern vehicles with forced-air heating the installed load of 45 kW is composed as follows: air heater for compartments and corridor 39 kW; lavatory water heaters, 2 kW × 2 = 4 kW; vestibule radiators 1 kW × 2 = 2 kW. These radiators are arranged horizontally on the lower lace of the partition wall.

Omnibus and suburban vehicles with radiators have a variable load, according to the volume, calculated on a basis of 220 to 250 W dissipated per m^3 of heating space.

The heating is calculated for an outside temperature of — 20° C. and a maximum speed of 160 km/h (100 m.p.h.) for compartment vehicles and 120 km/h (74 m.p.h.) for omnibus and suburban vehicles.

The capacity required of accumulators for electric heating installations in modern compartment stock with forced air heating is:

— ventilation motor	850 W
— drive and control accessories	100 W
Total. . .	950 W

Omnibus and suburban vehicles with radiator heating require 40 W for drive and regulation fittings.

The N. S. B. uses either hot air heating or direct heating by single heaters under the seats and in the corridors. For electric heating, the tension used is 1 000 V. It is intended to build coaches with an installed load of 200 W/m^3. Heating is calculated for a temperature rise of about 40° at speeds up to 100 km/h. The electrical power required from accumulators for hot air central heating is only the current necessary for operation (about 200 W). Corridor radiators are arranged along the outer walls below metal casings.

The N. S. uses hot air heating by combined steam and electricity. Air is taken from outside by a ventilator with electric motor and blown through the heating battery to ducts which distribute the air to the various compartments of the vehicle.

The advantages of the system are:

1) the degree of heating is uniform;

2) the air is filtered before entering the ventilator so that the warm air is clean;

3) by forced air heating there is a slightly increased pressure in compartments which discourages the entry of dust and draughts during running.

The tension used is 1 000 V A. C., 16 2/3 or 50 cycles or 1 500 or 3 000 V D. C. and the installed load is 35 kW for 1st., 2nd. and 3rd. class coaches and 25 kW for luggage and restaurant cars.

Hot air is distributed so that the temperature is about equal in all parts of the coach.

For speeds of 100 km/h. and an outside temperature of — 15° C., the inside temperature should be 18° C. and is thermostatically regulated.

The C. F. F. uses resistance heating radiators. Forced air heating is used only in some R. I. C. coaches with heating for different tensions. The tension is 1 000 V 16 2/3 cycles but can be reduced to 800 V by means a commutator on the locomotive. This tension is used during spells of relatively cold weather.

The installed load is 32 up to 40 kW or about 320 W/m^3 for a third class coach.

Radiators are placed along lateral walls and under seats at the far end of compartments.

Heating is calculated for an outside temperature of — 20° C. at 125 km/h. and the battery is charged at 85 — 130 W.

In corridors radiators are placed along the outer lateral walls.

The E. B. T. B. uses radiators only, the heating tension is 800 — 1 000 V, installed load 300 — 350 W/m^3 for 2nd. class and 200 — 300 W/m^3 for 3rd. class, and heating calculated for an outside temperature of — 15° C. and 80 km/h.

C. 2. — II. Railcars.

Electric heating is not used in railcars except as supplementary heating (see Chapter C. 3, II), on the S. N. C. B. and N. S.

C. 2. — III. Motor coaches.

The 1935 type motor coaches of the S. N. C. B. are heated by forced air, the 1939, 1945 and 1950 types by radiators.

Forced air heating is insufficient at low temperatures.

Radiator heating is the simplest and most efficient.

Tension used is 3 000 V and installed load is :

1935 motor coaches :

- 35 kW each coach. Radiators placed in a single box under the frame.

1939 motor coaches :

- 30.2 kW for 2nd and 3rd class composite coaches.
- 26.4 kW for 3rd class and luggage composite coaches.

1946 motor coaches :

- 31.8 kW for 2nd and 3rd class composite coaches.
- 31.6 kW for 3rd class and luggage composite coaches.

1950 motor coaches :

- 32.2 kW for 2nd and 3rd class composite coaches.
- 32.4 kW for 3rd class and luggage composite coaches.

Temperature is 17° to 19° C. inside for — 10° outside at 120 km/h.

Radiators are coupled in series and preferably placed along the outer lateral walls and transverse vestibule partitions with a power of about 240 W/m³. Temperature is regulated by thermostat. In the 1935 coaches the ventilator motor uses 1 500 W per coach.

The S. N. C. V. (Belgium) electric motor coaches have radiator heaters at 600 V; heating is calculated for 60 km/h. (37 m.p.h.) and 1 kW radiators are arranged under the seats.

In the D. S. B. motor coaches 11 kW per vehicle is used spread equally over the different parts of the vehicle. Tension is 1 500 V D. C.; most radiators are placed under the seats and coupled in two groups.

S. N. C. F. motor coaches use a tension of 1 500 V D. C. and heating is calculated for an outside temperature of — 20° C. and a speed of 120 km/h., with a load of 220 — 250 W/m³ heated volume. On recent cars there is no automatic regulation and the accumulator battery is not used for heating.

R. A. T. P. coaches run underground and there is no need for heating.

The N. S. B. uses radiators (electric heaters) in several types of vehicles (former trailers and projected new motor coaches) and circulated air heating in other types. Both systems provide almost the same comfort.

Current is 1 000 V A. C., 16 2/3 cycles, and the total heating load per vehicle for passenger compartments is :

—	Fast trains	Suburban trains
Electric heaters . . .	—	20 kW
Circulated air	30 kW	30 kW

To this must be added the separate heating for driver's compartment, lavatory, etc. (electric heaters).

In the compartments, the radiators are arranged as finned tubes on the floor below the seats, or sometimes as heating elements below a casing along the lateral wall. Heating is calculated for an outside temperature of — 20° C. Running speed of fast trains, 120 km/h., suburban trains 70 km/h.

N. S. motor coaches have 1 500 V D. C. heating and use hot air from a 30 kW heating battery for each unit of the set; the driving compartments each have three 450 W radiators. Heating is calculated for an inside temperature of 18° C. an outside temperature of — 10° C. and speed of 125 km/h. 500 W per unit of a set is specified for heating installations.

The C. F. R. uses radiators on outside walls and under seats; 300-300 W/m³ is

used in 1st and 2nd class compartments and 250-300 W/m³ in 3rd class. Heating is calculated for inside temperature of 20° C. and a speed of 65 km/h.

C. 3. Heating by other systems.

C. 3. — I. Carriages.

A certain number of D. S. B. carriages used in both railcar and steam sets have hot water heating. Usually, the boiler is placed under the coach and coke-fired. Sometimes it has a coil for heating water by using steam when the vehicle is in a steam train.

Hot-water heating has the advantage that the vehicle is independent of other vehicles in the set and can be used both with railcars and with steam locomotives, but it has the drawback of possible damage in very cold weather if insufficient care is not exercised during stabling. In addition, heating of several boilers is more onerous than the use of a single central boiler. In some coaches the boiler is placed in the vehicle and water circulated by an electric pump. It is intended gradually to eliminate the use of hot water heating (see also Chapter C. 3, II).

C. 3. — II. Railcars.

The heating systems used on S. N. C. B. railcars are of four kinds :

1) *Hot-water heating from the motor cooling system.*

This type of heating is used on light railcars.

Hot water radiators in the cars are fed from the motor cooling circuit.

The system is simple and economical. It has, however, the following disadvantages : the heat from the motor running slowly is insufficient to provide adequate heating before the first departure; this results in insufficient heating in very cold weather, particularly during the first workings in the day. The system is acceptable only for omnibus trains on secondary lines where passenger journeys are relatively short.

2) *Hot water heating from a boiler.*

This is used in single cars.

Radiators in the car are fed by an « Ideal Classic » boiler, fired by anthracite or coke.

This method has the advantage of complete independence of the motor and electrical equipment. It is simple, relatively cheap and gives efficient heating. Drawbacks; difficulty of regulating the fire and need for coal supply; space required, necessitating a special cabin for its installation.

3) *Forced hot air heating.*

This arrangement is used in 1939 type, single, double and triple cars.

Each car has a completely independent heating and ventilating system.

In winter, the air intake passes through a heater. This feeds the air distributors placed under the seats.

The heater is fed by a Westinghouse fuel-oil burner, with automatic on/off thermostatic control from a compartment.

The thermostat maintains temperature inside compartments at 18° to 22° C. by in and out operation of the burner at these respective temperatures.

The installation has safety devices.

It is very efficient, provides easy preheating, requires no supervision by train staff after switching on and uses the same fuel as the motor. It also removes stale air. Consumption is low.

On the other hand, the installation is fairly complicated and expensive. It requires good maintenance and risk of defects is higher than with the systems mentioned above.

4) *Heating by air conditioning.*

This is used on the 1936 triple cars.

The car has a central heating and ventilating equipment, located in the centre of the coach.

In winter, fresh air taken in is blown across a heater. The heated air is led by ducts to diffusers under the seats and

stale air is extracted by diffusers on the ceiling.

The heating element is made up of three parts :

a) a water/air unit for heating by circulated water which receives its heat from the motor cooling unit (during normal running);

b) a steam/air unit for pre-heating before going into service or during standing periods at stations;

c) an electric resistance/air unit for heating during coasting or standing (motor being insufficient). This resistance is fed by the principal generator.

Advantages : uses the calories of the water in the diesel motor cooling and renews stale air.

Drawbacks : complicated and expensive installation requiring good maintenance, pre-heating dependent on pressure in steam distribution system. Electric energy during coasting is relatively low in very cold weather.

The S. N. C.V. equips combustion-engined cars with heaters operated by the exhaust gases, using a special by-pass valve. Trailers can be heated from crude-oil heaters.

D. S. B. cars built before 1943 have hot-water heating and the boiler is normally under the body. In the « flash » trains, the boiler is placed in the coach and water circulated by an electric pump; each boiler heats 1 1/2 to 2 coaches of the set. The 1943 cars and those under construction are provided with a boiler and Pintsch steam heating, the boiler also producing enough steam for the trailers (see Chap. C. 3. 1.). The fitting of cars built before 1943 with steam boilers is under consideration.

Most S. N. C. F. railcars in service are heated either by exhaust gases from the motors circulating directly through radiators set in the bottom of the walls or, less often, by motor cooling water circulated through radiators in the passenger compartments.

Several railcars in service have a hot-water boiler, coal or oil fired, for heating compartments and pre-heating the motors in winter. This arrangement is technically satisfactory but onerous and is not being continued.

Exhaust gas heating is very irregular (excessive when motor is running on full load, nil on long idling periods) and causes risk of fire, particularly by reason of the difficulty of maintaining pipes in good condition.

Direct heating by motor cooling water requires very large radiators and the necessarily complicated circuits are liable to freezing in winter.

The heating system decided upon, which has been in use for several years on a certain number of railcars, uses very small aerotherms of 2 200 cal./h. (for 70°) distributed in the compartments, fed from the motor cooling water, the electric ventilators started or stopped by a thermostat. This solution, of small volume, gives full satisfaction providing, of course, that the motor cooling circuit is fitted to maintain the water temperature between 60 and 80°.

Heating of railcar trailers now in service is by a hot-water boiler, coal-fired, normal thermic-syphon circulation or increased circulation by steam pulsation.

This method requires careful supervision and is liable to freezing.

Encouraging trials are in hand for heating trailers by air circulating through an oil-fired heater (Westinghouse system, used in Belgium, and a similar one of French conception).

The C. F. A. Renault A. B. V. railcars use motor cooling water heating.

The four C. F. G. railcars are heated by exhaust gas from the Diesel motors. A two-position valve directs the gas either to the radiators or to the atmosphere, in each case through a silencer.

S. G. C. E. coaches are heated by circulation of hot air. The air is heated by the exhaust pipe. A blower driven by an electric motor directs the air through a wrapper tube, where it is heated by the

exhaust pipe. Hot air collected from the exhaust pipe is conducted to appropriate parts of the coach.

Heating is calculated for an outside temperature of 0° C. and an interior temperature of 15° C.

The N. S. B. uses hot water heating. The water is circulated in finned tubes or radiators. Water is heated by a coke-fired boiler below floor level. Heating can also be provided through the cooling water of combustion motors and the boiler mentioned. The temperature of the heating element surfaces is moderate and provides a comfortable heat.

Trailer vehicles are heated similarly to the above, by a coke-fired boiler.

On the N. S. quintuple Diesel-electric sets have hot air heating. The two central air-heating batteries are placed in the motor-coaches on each side of the motor compartment. They are heated by the Diesel motor cooling water.

Whilst standing with the Diesel motors not running, this cooling water is heated by an oil-fired boiler, thermostatically controlled. The cooling water temperature is therefore always high enough for good operation of the heating batteries.

As the farthest vehicle cannot be heated sufficiently in very cold weather, an additional heating battery has been installed, fed by two auxiliary generators coupled to the Diesel motors.

The characteristics of the system are :

1) Main heating battery in motor coach :

Ventilator input	5 300 m³/h.
Capacity	100 000 cal/h.
Heating by Diesel cooling water.	
Ventilator rating	3 680 W

2) Secondary battery in motor coach :

Input of air	2 200 m³/h.
Capacity	43 000 cal/h.
Heating by Diesel cooling water.	
Ventilator rating	660 W

3) Heating battery for furthest coach :

Ventilator input	2 200 m³/h.
Capacity	25 800 cal/h.
Heating by : 30 kW electric supply (150 V 200 Amps).	
Ventilator heating	600 W

The drawback of the system is that the additional electric heating required in coach No. 1 works only when the Diesel motor is running, i.e. it is necessary to run at least two motors at reduced power if it is desired to use electric heaters for pre-heating. Regulation demands particular care by personnel in this case.

C. 3. — III. Rail motor coaches.

Electric heating only is used in motor coaches, see Chapter C. 2, III.

C. 4. Regulation of heating.

C. 4. — I. Carriages.

S. N. C. B. internal service vehicles fitted with steam heating have Westinghouse regulators.

Internal omnibus service vehicles with combined steam/electric heating have Westinghouse automatic steam regulation and thermostats working contactor relays for automatic electric regulation of the whole carriage. International carriages with combined steam/electric heating have automatic regulation by thermostats and common controls for steam and electricity. In addition, in each compartment a switch is fitted and the passengers may shut off, put on permanently or regulate thermostatically the heating system.

Automatic thermostatic regulation operates when the temperature reaches 18° C. with a tolerance of + or — 2°.

In D. S. B. carriages with Pintsch steam heating, the train staff regulates the heating according to the outside temperature. In side corridor coaches valves are installed to allow passengers to cut off 2/3 of the heating.

Electrically heated coaches of 1 000, 1 500 and 3 000 V have thermostatic regulation at 20° C. + or — 1.8°, but a switch in each compartment allows heaters to be switched off. In coaches for Norway and Sweden (see Chapter C. 2. I) the electric heating is 1 000 V only and there are switches in the passenger compartments.

Temperature regulation in S. N. C. F. carriages is automatic, by a central regulator based on the Wheatstone bridge principle with « invar » resistances and ultra-sensitive resistances operating with variations in temperature.

The current passing the Wheatstone bridge operates an electric relay which controls a circuit operating an electric valve or contactor closing and opening the steam or electric heating circuit. Regulation is on or off only.

If the regulator does not function, temperature can be controlled manually by the train staff.

Automatic or manual regulation affects the whole carriage and is done by control from the general temperature at various parts of the vehicle (maximum tolerance allowed, 2 degrees).

In carriages with forced air heating a gauge allows the air passage section at the different outlets in each compartment to be varied.

In radiator heated coaches the power is calculated in functions of the cube of air to be heated.

The regulation of the average temperature in the coach is by eight feelers distributed over the coach, which form the eight variable resistances of the Wheatstone bridge mentioned above.

The average temperature provided by day is 21° C. and by night 23° C., maximum tolerance allowed being plus or minus one degree.

On the C. F. A. a regulator handle is at the passengers' disposal for each compartment. The steam heating pressure at the locomotive varies according to the number of heating units and the outside temperatures.

On the C. F. M. a thermostat regulates each compartment.

The N. S. B. have regulation by train staff and passengers simultaneously or automatic by thermostats.

Regulation in N. S. carriages is done by train staff and passengers together, or automatically. Regulation by train staff of steam heating is done through the admission valve orifice and of electric heating by selection of current and power (3 000 V: full only; 1 500 V: full and half; 1 000 V: full and 2/3).

Regulation by passengers: admission of hot air into compartments can be partially controlled by passengers.

Automatic regulation: four compartments have thermostats, which are mounted in two series. If at least two thermostats in series shew « cold » the heating is switched on. If at least two thermostats in parallel shew « warm » heating is cut off.

In C. F. F. coaches, the train staff can put the heaters on or off by a main switch, which can be operated only by a carriage key. In addition, each compartment has a manual switch by means of which the train staff or passengers can regulate the heating as desired.

Thermostats working contactors also regulate heating, each compartment is controlled separately. The thermostats are bi-metal, average temperature 18° C., adjustable from 14° to 20° C., tolerance + or — 1°.

On the E.B. T. B. temperature is regulated by train staff and by passengers, and in new stock by thermostats; average temperature is 15° C.

C. 4. — II. Railcars.

On the S. N. C. B. railcars with hot water heating from the cooling system there is no regulation. With hot water heating from a boiler the radiators are grouped in circuits. Each circuit (per compartment) has a regulator valve operated by the train staff. This valve is also charged from the fire ducts.

In railcars with hot air heating there is

thermostatic regulation for the whole of the car.

With air conditioning the staff have only to attend to the preheating. Regulation for the whole car is done automatically by a thermostat in the air intake for replacement of stale air.

Automatic thermostatic regulation operates at 18° C., with a tolerance of + or — 2°.

On the S. N. C. V. the train staff regulates the heating; the average temperature is 15° C.

On the D. S. B. the train staff regulates the temperature for the whole car.

With exhaust gas or individual boiler heating, the S. N. C. F. regulates heating for the whole coach by the train staff. The standard equipment (aerotherms) includes automatic thermostats; the same applies to trailers with forced air heating.

Thermostats are set for an average temperature of 18° to 20° C., operating at + or — 2°. Results have been very satisfactory.

On C. F. A. railcars, the conductor is responsible for regulation.

C. F. G. railcars are regulated by the staff of the train for the whole car.

This regulation is « on » or « off »; there are only the two positions on each control valve, open or closed. Each Diesel feeds one heating circuit, there is no connection between the two.

S. G. C. E. cars have regulation by the train staff. A regulator controls the quantity of fresh air and consequently the degree of heating.

On N. S. B. railcars, regulation is normally done by the train staff, but can also be controlled by the passengers. Automatic regulation is not used. Each compartment can be regulated separately, and manually operated.

N. S. cars have the following systems :

Regulation by train staff : there is no regulation other than switching on the additional electric heating battery and ventilators.

Regulation by passengers : nil.

Automatic regulation : the thermostat in car No. 1 controls the power from the additional battery. If the thermostat registers warm the power is 30 kW. If it registers cold the power is reduced to 5 kW. The thermostats in coaches 2 and 5 control the direction of air across the heating batteries in the motor coaches. If they register « warm » the air passes over elements carrying the motor cooling water. If they register « cold » the air goes through a by-pass. Between these two positions of the thermostat air passes both over the heating battery and through the by-pass duct.

C. 4. — III. Motor coaches.

On all types of S. N. C. B. rail motor coaches there is automatic regulation by a thermostat for the whole vehicle. The inside temperature is set, as for carriages and railcars, at 18°, ± 2° C.

Modern S. N. C. V. coaches have thermostatic control, average temperature : 16° C.

In D. S. B. cars heating is regulated by the driver, according to outside temperature : at full, 2/3 or 1/3.

In S. N. C. F. cars regulation covers the whole vehicle and is put on or off by the motor-man according to instructions covering the duration of heating or non-heating, according to outside temperature.

N. S. B. cars have automatic temperature regulation by thermostats which switch off the heating battery, this latter being manually adjustable for three stages (10, 20 and 30 kW). Regulation affects the whole vehicle.

Electric thermostats keep the air temperature at about 20° C. in fast trains and about 18° C. in suburban trains. Limits + or — 1°.

On N. S. motor coaches the staff can apply full or half-power heating. A thermostat in each unit of the train completes this regulation by cutting out in the « cold » position half the power put through by the train staff. Tabulated, this regulation is as follows :

Thermostat position	Full heating	Half heating
« Hot »	30 kW	15 kW
« Cold »	15 kW	7.5 kW

Passengers have no means of control. The thermostats are set at 18° C. The temperature ranges in the coach, caused by the operation of the thermostats have not been measured, but test have shown that their operation is not yet fully satisfactory as air currents in the vicinity of the thermostats are inevitable.

Regulation of temperature on the C.F.R. is effected by the train staff and by the passengers in each compartment. The following positions are available 1/2 full, or 1/3, 2/3 and full.

C. 5. Ventilation.

C. 5. — I. Carriages.

S. N. C. B. stock built before 1936 was in general fitted with torpedo type ventilators. Since 1936, Schepens blowers (see fig. 4) have been used. The ventilators are set on the compartment centre line on centre corridor vehicles, and along the corridor side of side corridor vehicles.

It should be noted that lavatory compartments are *always* fitted with a torpedo exhauster ventilator, which combined with the forced intake in the compartments, prevents lavatory odours from the lavatory penetrating into compartments. In addition, ventilation is also provided by window lights.

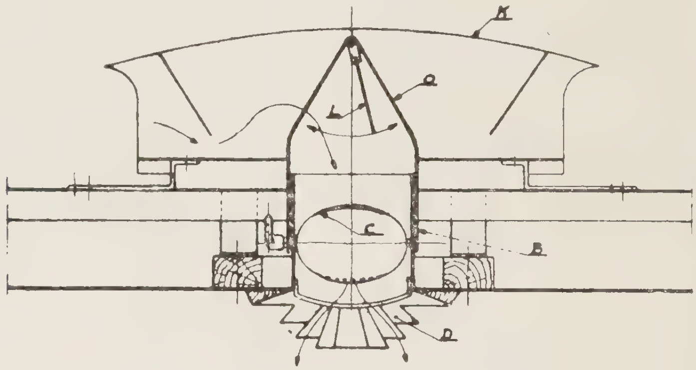


Fig. 4. — S. N. C. B. diffuser type ventilator.

A deflector plate K, mounted on the roof, admits air from one side or the other according to the direction of travel.

The air forces an aluminium flap L against the opening O in such a way as to direct air downards through the duct B where it is injected into the compartment through a diffuser D which spreads the air in different direction. Stale air is expelled through the door and window slots or openings.

The rotating flap C allows the entry of air to be adjusted or stopped.

With this system of ventilation, fresh air is introduced from above and stale air is expelled from the lower part.

So far, the system used has been as follows :

International coaches : all lights can be lowered.

Internal coaches : all lights can be lowered; one fixed light, one drop-light.

In future all lights will be drop-lights.

In lavatories, the exhaust ventilator remains permanently fully open.

Compartment air-intake equipment is provided with the following arrangements :

International vehicles: regulation by passengers.

Omnibus vehicles : compartments, regulation by passengers.

Large vestibules : regulation by passengers.

Up to 1944, the D. S. B. used torpedo type exhaust ventilators for compartments and Chanard blowers for toilet compartments. On modern vehicles, compartments are equipped with Kuckuck exhausting ventilators and toilet compartments with exhaust and intake ventilators of the same kind; they can be regulated by passengers.

All windows are of the half drop type.

S. N. C. F. coaches are ventilated by fixed extractors mounted on the roof. Forced ventilation fittings are used only on pneumatic-tyred vehicles.

The two motor ventilator groups used for forced air-heating inject into the carriages about 2 400 m³/h. of filtered air, taken from outside and diffused into its upper part along the centre line.

The ventilators are of the centrifugal type running at a speed of 2 350 r.p.m.

The means of ventilation can be adjusted by the passengers.

The C. F. A. uses Irle type extractor aerators in compartments and Chanard blowers in toilets. Ventilation cannot be adjusted by passengers, but the window lights are moveable and can be opened by passengers.

The C. F. M. effects ventilation by two extractors situated at the ends of the coach, connected by a duct running above the corridor; an aperture from this duct is provided in each compartment and can be adjusted by the passengers. Compartment windows are moveable.

The C. F. I. uses Chanard type blowers and Parisien type extractors, as well as adjustable inlet louvres, manually operated, and turbo-blowers. There are moveable window lights.

The N. S. B. uses extractors mounted in the roof.

Some modern vehicles have a heating battery with electric blower above the coach. Pure air is drawn through orifices in the lateral walls and passed into the compartments. In summer the air is not heated. The heater is either steam or electrically operated.

It can be regulated by passengers, usually for each compartment.

In summer, N. S. carriages have only natural ventilation by roof-mounted ventilators. In passenger compartments the ventilators are extraction type and with blowers in the toilets (see fig. 5). In winter, forced-air heating gives a complete change of air about 11 times per hour.

Passengers can close the roof ventilator opening and, partly, the hot air admission opening.

Lights can be fully opened by the passengers.

In C. F. F. centre-corridor vehicles the end compartments and vestibules are each fitted with a fixed roof-ventilator. The central compartment has two ventilators. In side-corridor coaches each compartment has its own ventilator.

The ventilators are extractors and are mechanically controlled.

C. F. R. coaches are fitted with Flettner, non-rotating, ventilators; passengers can close these ventilators in the roof.

Renewal of air in E. B. T. B. carriages is by means of blower ventilators, roof-mounted and adjustable by the passengers.

C. 5. — II. Railcars.

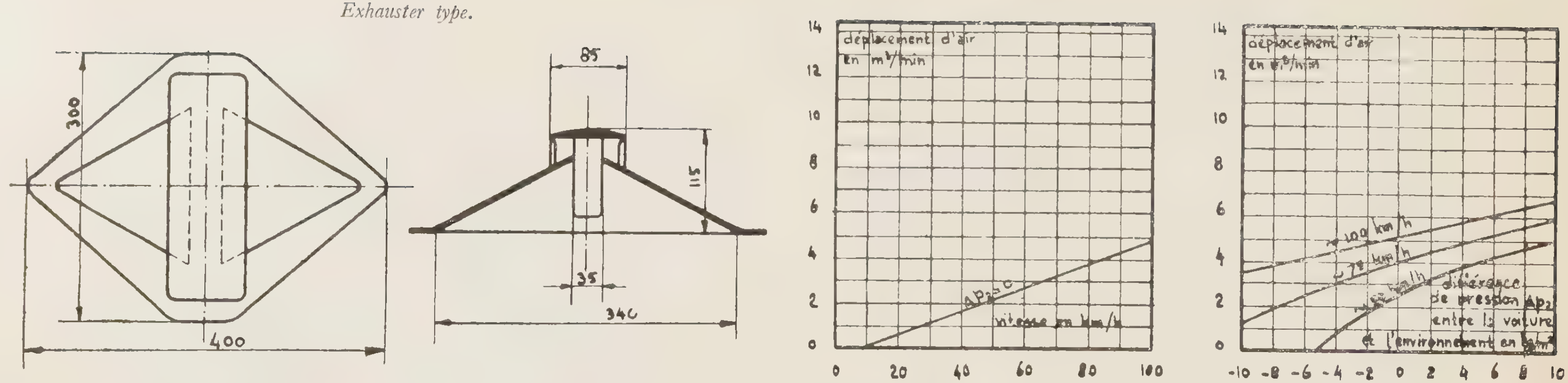
S. N. C. B. railcars with hot water heating have torpedo or Bob ventilators.

When forced air heating is used the heating and ventilation systems are combined.

In winter, the forced hot air is fresh air injected from outside.

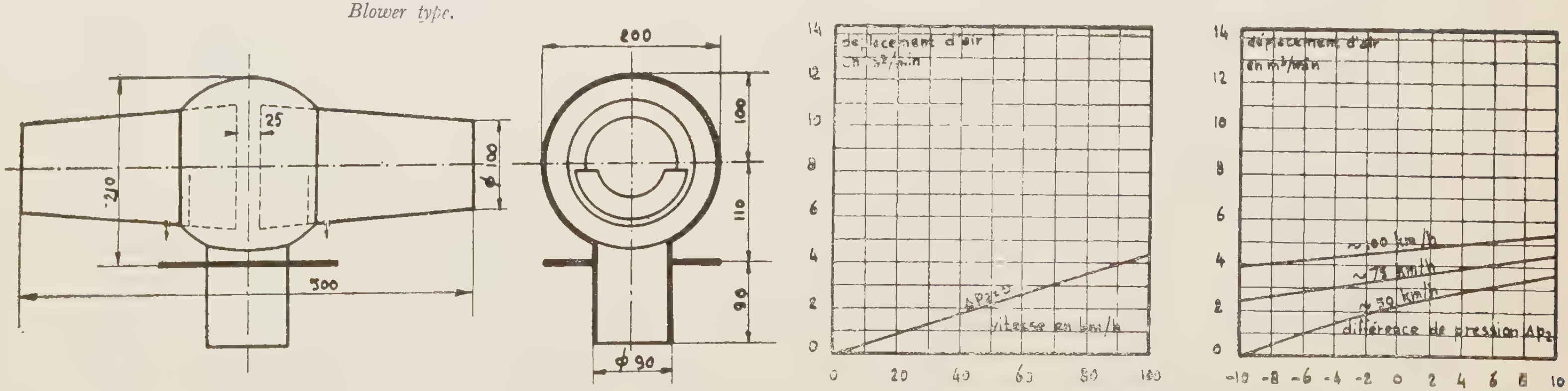
In summer, in the 1939 type triple rail cars, the fresh air taken from outside is

Exhauster type.



Ventilation aperture 75 cm². — Area of roof aperture 150 cm². — Aluminium construction.

Blower type.



Ventilation aperture 117 cm². — Area of roof aperture 64 cm² — Brass and zinc construction.

Fig. 5

distributed without going through the heater, by means of distributors in the roof.

In addition, the passenger may, by operating a handle, either diffuse the air injected or direct it towards himself from suitable orifices.

In the 1939 single and double cars, it has been considered sufficient to extract stale air through diffusers placed under the seat and ventilation is completed by anemostats, Schepens type, roof mounted.

Further, air conditioning provides a combined heating and ventilating system.

In winter, by forced hot air as described above.

In summer, the same installation serves for ventilation. Fresh outside air is distributed from roof-mounted appliances. Stale air is extracted by distributors under the seats and released to the atmosphere.

The passenger can adjust ventilation as on the 1939 triple cars.

Ventilation of railcars is also effected by moveable window lights. So far, the following systems have been used :

Sliding panes in the tops of the windows.

One third of the light sliding upwards into the bodywork.

Moveable portion of window lights can be operated by passengers.

The S. N. C. V. uses only fixed extractors and injectors.

In D. S. B. railcars ventilation is normally the same as in carriages. In first-class compartments of some « flash » trains, they have provided forced ventilation or a ventilator with electric motor for extracting stale air. Ventilation is controlled by the passengers.

In S. N. C. F. railcars ventilation is by half-opening windows arranged in principle on one side of the coach, and by fixed roof extractors.

Some de luxe cars have fixed lights and forced ventilation (by fixed blowers combined with electric extractor ventilators).

Ventilation can be adjusted by passengers.

The S. G. C. E. and the C. F. A. use aerators with shutters operated by the train staff.

In C. F. G. cars the air is extrated by aerators, combined electric and fixed, roof-mounted; air is injected after filtering, by aerators fixed between the window lights.

All ventilators and moveable lights can be adjusted by the passengers.

C. F. I. railcars have ventilators with cut-offs and two air outlet holes in the roof. There are part-opening windows.

On the N. S. B. pure air is introduced by ducts in the roof; electric blowers are fitted in the ducts. Ventilation cannot be adjusted by the passengers.

Generally four lights in each compartment can be opened or closed by staff or passengers.

In summer the forced air heating system of N. S. railcars is used for ventilation, effecting a complete change of air about 16 times per hour. In winter, there is no noticeable difference. Ventilation cannot be adjusted by passengers. The lower half of the window lights is fixed, and the top half can be opened by the passengers.

C. 5. — III. Motor coaches.

Schepens blower ventilation is also used in the 1939, 1946 and 1950 coaches of the S. N. C. B. The ventilators are placed in the centre line of compartments.

As in carriages, the lavatories are *always* provided with torpedo type extractors.

Apart from the ventilators, there are also moveable panes in the window lights.

1935 motor coaches : all windows have drop lights.

1939, 1946 and 1950 coaches : alternate windows are fixed, the others are half-opening.

In future coaches the full drop light arrangement will be used.

In lavatories the extractor ventilator remains fully open. With the compartment blower ventilators the passengers regulate the compartment ventilation and the train staff the large vestibules.

The S. N. C. V. uses extractors and blowers and in modern coaches forced ventilation.

Ventilation of D. S. B. motor coaches is the same as that used in carriages. Some windows are fixed, most are part-opening and can be adjusted by passengers.

The S. N. C. F. has the same system of ventilation in motor coaches as in railcars.

R. A. T. P. rail motor coaches, running mainly in tunnels, are ventilated naturally by window opening on both sides, this opening being either left to the travelling public or adjusted in a specified manner by the staff. In addition, the rof of each coach has a clere-story with lateral openings and director vanes to assist entry of air at one side and extraction at the other.

In N. S. B. vehicles, provided with hot-air heating, the system is also used for ventilation so that the fresh air is drawn in, heated and injected into compartments. In summer the system is used without the heater.

In vehicles with separate electric heaters there are extractor ventilators in the roof.

In all vehicles there are half-opening windows, vertically-sliding.

The ventilator blows into compartments and is not adjustable by passengers.

The extractor ventilators can be adjusted by passengers except in earlier trailers, where they are permanently open.

All sliding windows can be opened by passengers.

The information given with regard to N. S. railcars applies also to their rail motor coaches.

As regards C. F. R. coaches, the information given for carriages applies also to rail motor coaches.

C. 6. Air conditioning.

As mentioned in Chapter C. 5. II, the S. N. C. B. uses forced air heating and conditioning in railcars.

Caractéristiques	Triple railcars 1939	Double railcars 1939	Single railcars 1939	Triple railcars 1936
Air renewal : winter	7 to 8	7 to 8	7 to 8	12 to 14
Air renewal : summer.	20	8	8	20
Heating power, cal/h.	68 000	56 000	28 000	65 000

The systems used do not include humidifiers or coolers for summer.

Only the 1935 cars have been fitted with air conditioning equipment. This has subsequently been simplified by reduction to a system of forced air heating for winter use.

The S. N. C. F. has no coach or railcar fitted with air conditioning.

Only the first-class railcars of the express sets, T. A. R. type, include an air cooling system, by ice containers, which does not really constitute air conditioning.

The R. A. T. P. emphasises that air conditioning is not to be recommended for metropolitan lines; it is too exacting and impossible to regulate owing to variations in loading and the opening of doors.

C. 7. Thermic insulation.

C. 7. — I. Carriages.

The acoustic insulation in S. N. C. B. carriages — mentioned in Chapter A. 2 — acts also as thermic insulation.

The choice of materials was made following laboratory tests.

These tests gave the following results :

Glass wool : 27.7 cal.
Isoflex : 32.2 cal.

for 1 mm thickness, 1 m², 1 hour, 1 degree of difference between walls.

No measurements were taken in coaches.

These trials can be undertaken in the installations of specialist firms, such as those having refrigerated depots.

In D. S. B. carriages the acoustic insulation described in Chapter A. 2 acts as thermic insulation also.

For thermic insulation of coach bodies the S. N. C. B. uses interior dressings of insulating material (compressed or laminated wood) on wooden brackets, with air spaces between the metal framing and the furnishings.

The wooden floor is spaced away from the general chassis plates with strips of asphalt felt (floor) and padding (upper parts) between the furnishings and the brackets.

S. N. C. F. coaches at present on order have thermic, and at the same time acoustic insulation by a flock dressing in the interior faces of the outer panels, about 2 mm (5/64″) trick. The stocks is only in course of delivery and an objective report on the degree of insulation achieved cannot yet be made.

Apart from this, comparative trials have also been made with another type of carriage between flock and spray dressings of 2 mm flock and 10-12 mm (25/64″-15/32″) spray. Trials were made at night to avoid the influence of sunshine. The two coaches in question were heated to give a uniform ambient temperature (about 40°); the heating was then cut off and thermometers placed at different points in the vehicle shewed the free cooling curve in function of time: the outside temperature curve was plotted to allow for the necessary corrections. These trials shewed that cooling was approximately the same with the two products under test, the interior temperature in the two coaches being about 14° at the end of 12 hours, then decreasing only very slowly (the exterior temperature being 11° C. at this time).

The S. N. C. F. is dealing with this matter as complementary to acoustic insulation, and trials of other materials are under consideration.

The C. F. A. uses Alfol sheets for thermic insulation.

In C. F. M. carriages thermic insulation is achieved by using a maximum of timber for the outer coachwork (floor, lateral walls, roof) and interior panelling (backed with compressed paperboard). Insulation is completed by the air space provided between the outer bodywork and interior panelling of walls as well as the floor.

In C. F. I. carriages, Celotex, Alfol, or cork are used in the walls.

For thermic insulation, the N. S. B. uses the same materials as for sound-proofing: Isoflex, Isolit, Wellit, Arki mattresses (wrack) and glass fibre.

The N. S. uses Isoflex for insulation of walls and roof and cork for the floor.

The insulation used achieves some degree of sound-proofing, but is not used specially for this purpose.

The co-efficient of heat-transmission for Isoflex is given by the suppliers as 0.040 kcal/m²/h./° C./m.

That of cork is about 0.030 kcal/m²/h./° C./m.

No trials have been made to test the degree of insulation in a carriage.

In C. F. F. coaches, the floor is covered with a thin layer of cork. The methods and materials used for thermic insulation are the same as those for sound insulation.

In all light vehicles, the sides, ends, roofs and floors have an interior application of sprayed asbestos-base, Limpet brand, supplied by J.W. Roberts,. of Armley, England. The thickness applied is 10-12 mm. The area treated is about 160 m² per coach.

C. 7. — II. Railcars.

The information given for S. N. C. F. and D. S. B. coaches applies also to their railcars.

The S. N. C. V. effect thermic and acoustic insulation by asbestos fibre with adhe-

sive applied by spray pistol to a thickness of 10-8 mm (5/16″-25/64″).

S. N. C. F. railcars have thermic insulation by « flockage » of panels or a dressing of glass wool, cork or Alfol.

In the conditions in which it is used, the thermic insulation material has little effect; moreover, by reason of their light construction, railcars have a calorific capacity much lower than that of carriages.

In this respect, aerotherm heating is particularly good, since it allows the temperature inside compartments to be increased quickly in spite of the poor insulation; pre-heating devices are useless.

For thermic and acoustic insulation the S. G. C. E. has applied to the inner surfaces of panels a tar base cement and uses an interior timber facing.

In C. F. G. railcars, roof insulation has been achieved in the following manner : from the outside, the materials used are : deal boarding (15 mm [19/32″] thick), covered with roof canvas. A 3 mm (1/8″) layer of Seapak with aluminium facing (outside). A duralumin sheet 1.5 mm thick; four 3 mm thicknesses of fireproof Seapak, one corrugated, two aluminum faced (outside). A 3 mm layer of hard Isorel for the interior ceiling. Two air spaces are provided, one of 60 mm (2 23/64″) and one of 45 mm (1 49/64″).

The floor is composed of 4 mm (5/32″) linoleum, a layer of asphalted Isorel, 8 mm thick, a 3 mm thickness of hard Isorel and a 2 mm chrome-copper steel plate for vestibules and duralumin for passenger compartments.

These plates are treated with flock on both sides.

An air gap of 6 mm (15/64″) is allowed.

The lateral walls are formed of two flocked plates with air spacing.

These methods are the same as those used for acoustic insulation.

C. F. I. railcars are equipped for thermic insulation with timber roofing 10 cm (3 15/16″) above the bodywork.

The N. S. B. uses felt, glued to the outer metal plates of the wall and roof. This is the same as for sound insulation. In addition, porous panels of re-constituted wood are used.

No insulation is provided in these vehicles.

For thermic and acoustic insulation of walls, roof and floor. N. S. railcars have Cellotex, a mixture of compressed fibre and cement.

C. 7. — III. Rail motor coaches.

The thermic and acoustic insulation used by the S. N. C. B. S. N. C. V. and D. S. B. in carriages and railcars are also used in motor coaches.

The R. A. T. P. finds thermic insulation useless on metropolitan railways.

N. S. B. motor coaches use Isoflex or porous panels of re-constituted wood in the lateral walls; wrack or felt padding or impregnated corrugated paper (Wellit) in the roof; wrack padding, Isoflex or glass fibre in the floor. No details are given of the heat-transmission coefficients of the insulating materials.

For modern stock :

Isoflex : 0.038 kcal/m²/h./° C.

Glass wool : 0.030-0.035 kcal/m²/h./° C.

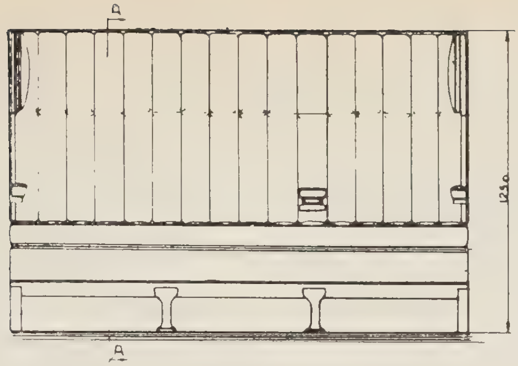
Insulation of coaches has not been measured.

The N. S. uses Isoflex and cork, as in carriages.

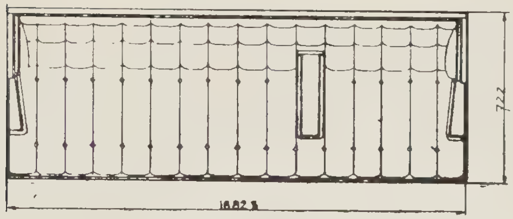
* * *

With regard to *double glazed windows*, the N. S. B. uses such lights in all modern vehicles.

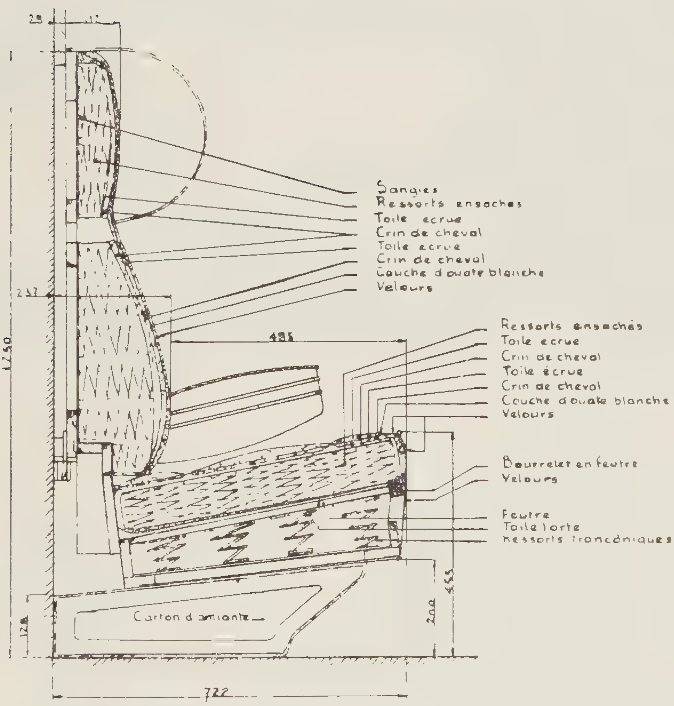
On the S. N. C. F. the question is only under consideration for carriages, but several railcars destroyed during the war had double-glazed windows. The improvement obtained by double glass was particulary noticeable from the point of view of sound-proofing. C.F.I. vehicles have double glazed lights coloured blue. The fixed, lower, part of windows in N. S. railcars and motor coaches is of double glass.



Front elevation.



Plan.



Section A-A

Fig. 6. — *S. N. C. B.* international coach. — Bench type seat for 2nd class compartment.

Explanation of French terms :

Sangles = Webbing. — Ressorts ensachés = Pocketed springs. — Toile forte = Brown holland. — Cuir de cheval = Horsehair. — Couche ouate blanche = Wadding, white. — Garniture velours = Velour trimming. — Feutre = Feld pad. — Toile forte = Strong hessian. — Ressorts tronconiques = Truncated springs.

As Triplex or toughened glass is used only as a measure of safety for passengers in case of accident, Administrations have been unable to comment on the thermic insulation properties.

* * *

D. INTERIOR DECORATION.

D. 1. Seats.

D. 1. — 1. Carriages.

In 1st and 2nd class carriages of the S. N. C. B. the seats are padded, and 3rd. class seats are wood.

The arrangement of an international, 2nd class, seat is given in fig. 6.

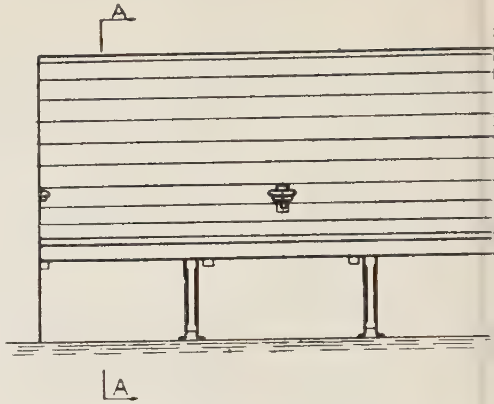
The seats have a base of semi-conical springs and pocketed-spring cushions. Between the cover and the springs there is a 10 mm hair overlay.

In fig. 7 is shewn an international, 3rd class, seat. Coaches under construction will have 3rd class padded seats also.

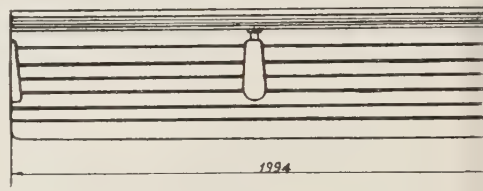
The D. S. B. use padded seats in 1st class and in one-class vehicles. The 1st class seats have cushions with pocketed springs. The seats and backs in both classes have Epeda type springs. Between the springs and the cover there is a hair overlay. Figs. 8 to 10 shew the arrangements in the different types of compartments.

Modern S. N. C. F. stock has in all classes sprung upholstery for seats, backs, arm and head rests.

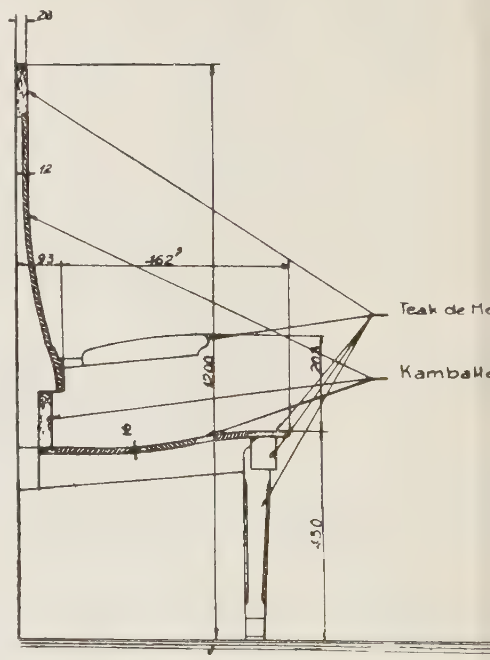
The upholstery comprises, for seat cushions, backs, arm and head rests, resilient trimming comprising rows of coil springs, contiguous and interlaced with each other and between rows. This type of mesh can be obtained either without knots, by weaving in clockwise and anti-clockwise directions alternately, a continuous wire to form each row of springs, or by means of individual springs interlaced and connected at the ends by lapping, which allows the stiffest portions to be layed on the surface to be upholstered. In both cases the padding is completed by a layer of curled animal hair.



Front elevation.



Plan.



Section A-A.

Fig. 7. — *S. N. C. B.* international coach. Bench type seat for 3rd class compartment.

Finally, the resilient trimming can be made up of independent pocketed springs, pinned or tied together and covered with an overlay of hair.

The construction of seats in C. F. A. carriages is shewn in fig. 11.

The C. F. M. use Simmons type seats, with pocketed springs for each seat, independent and removable, in 1st class compartments, and for each pair of seats in 2nd class compartments. Arm rests fold into the backs.

C. F. I. ordinary stock has padded seats in 1st and 2nd class compartments, and wood in 3rd and 4th class.

In 1st, 2nd and 3rd class semi-sleepers, the seats are padded with springs and hair.

The N. S. B. uses seats padded with hair, alfa fibre or felt; in 1st and 2nd class the seats and backs are provided with springs and cushions. In certain suburban 3rd class carriages the seats are of the tip-up type.

N. S. carriages have sprung seats in all classes. The backs are padded with springs or hair.

The difference between 2nd and 3rd class seats is in the degree of elasticity in the springing and the material used for the covers. The use of foam rubber is to have a further trial, previous trials having been rather unsatisfactory.

C. F. F. 3rd class seats are formed of oak laths. The head rests are trimmed with a light padding and leather cloth (see fig 12).

2nd class seats are padded. On one side of the corridor there is a seat for two persons, separated by an arm rest which can be folded into the seat back.

On the other side of the corridor there is a single seat (see fig. 13).

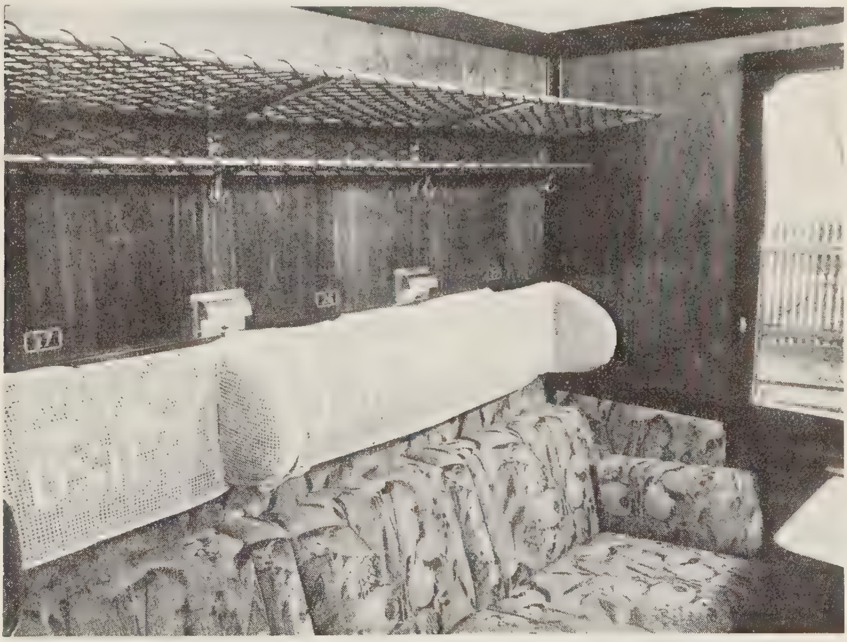


Fig. 8. — *Danish State.* — Side corridor coach, 1st. class compartment.

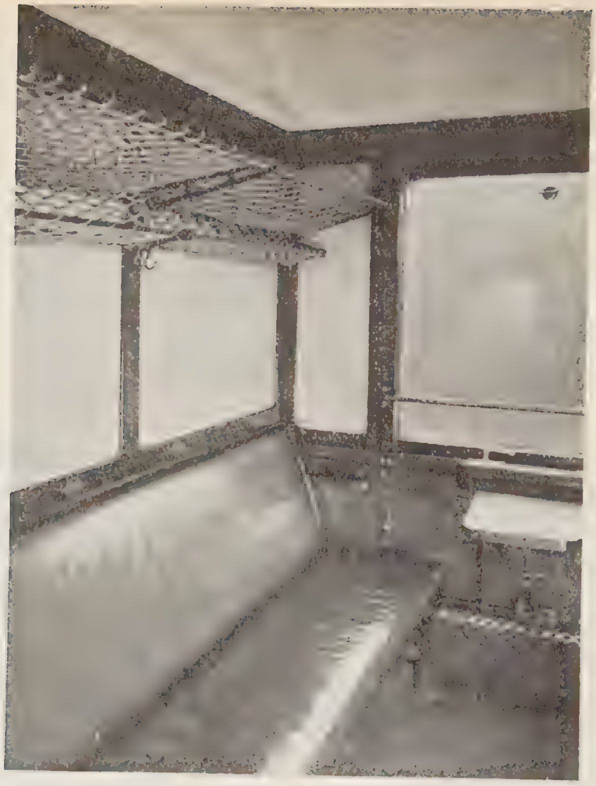
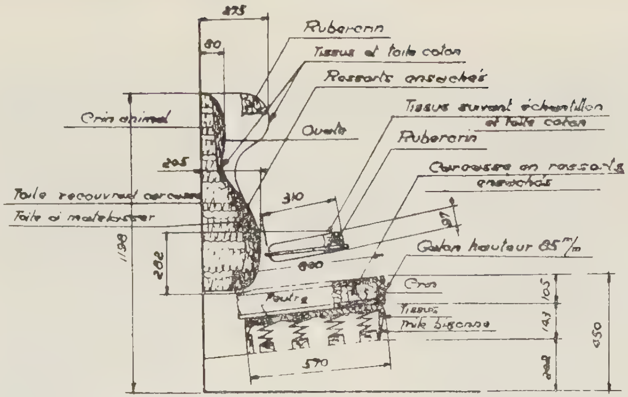


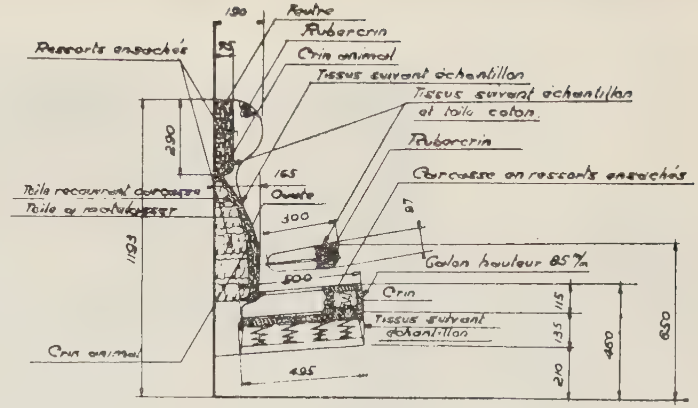
Fig. 9. — *Danish State.* — Side corridor coach, « single-class » compartment.

Fig. 10. — *Danish State.* — Centre corridor coach, « single class ».

1st. *class.*



2nd. *class.*



3rd. *class.*

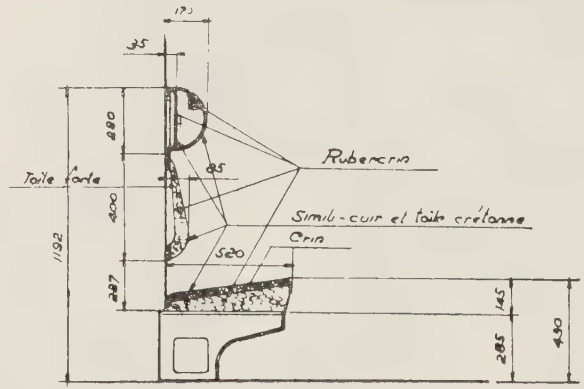


Fig. 11. — Seats for steel coaches.

Explanation of French terms :

Rubercrin = Rubberised fibre. — Tissus — Woven textile. — Ressorts ensachés = Pocketed springs. — Tissus et toiles adoptés = Woven textile to suit. — Hauteur du galon = Height of band, 85 mm. — Cuir animal = Animal hair. — Ouate = Wadding — Feutre = Felt. — Simili cuir et toile = Leather cloth and cretonne.

In side corridor coaches, series AB4u, the arm rests are movable cushions which can be placed by the passenger as desired (see fig. 14).

The springing used is preferable of Dea type with hair overlay. Tests are to be put in hand with foam rubber and rubberised fibre.

In 1st and 2nd class the C. F. R. uses seats with springs, in 3rd class the seats are of wood.

Modernised E. B. T. B. carriages are fitted with seats of the types standardised by the C. F. F.

In S. N. C. F. carriages there are seats in the 1st and 2nd class which can be converted into berths.

In the case of first-class carriages, the seat is continuous and mounted on bars to permit correct positioning of the seat to bring the seat surface semi-horizontal whilst the operation increases its width.

In the case of the second-class, the seat is also continuous and is connected to a mechanism which provides three berths simultaneously (see fig. 15).

It may be noted that in the 3rd class, the upper part of the seat is movable to provide a greater depth of seat.

C. F. A. 1st and 2nd class carriages have four berths per compartment (800 mm wide, 2 030 mm long and 1 400 mm high), with mounting steps for the upper berth.

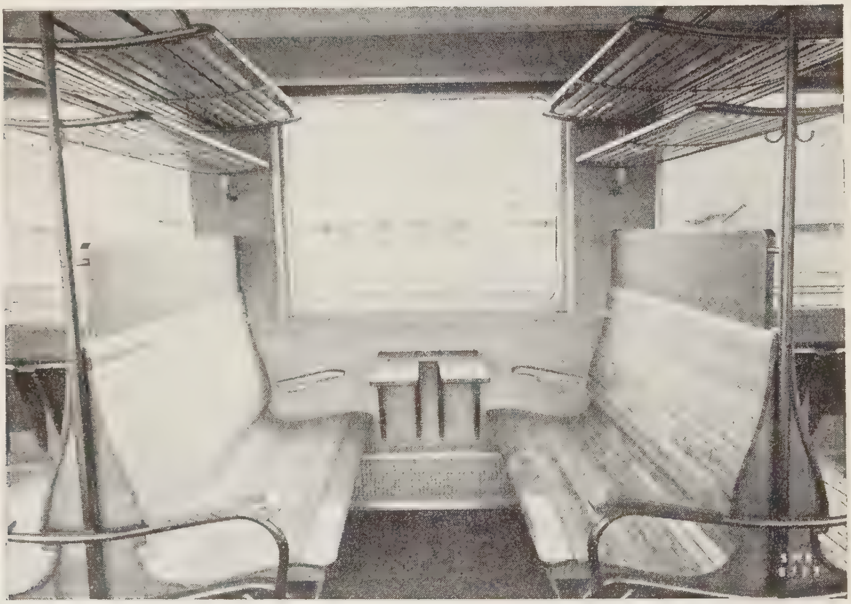


Fig. 12. — Interior of 4 seat, 3rd. class, compartment, centre corridor.

C. F. I. carriages also have seats convertible into berths.

N. S. B. sleeping cars have convertible seats, in 3rd class compartments there are 3 berths and in the 1st and 2nd classes, one or two berths.

In C. F. F. side corridor coaches the seats can be converted into berths by raising the backs (see fig. 16).

With regard to the material used for covering the seats, with of corridor and

Fig. 13. — Interior of second-class compartment, B4ij coach.

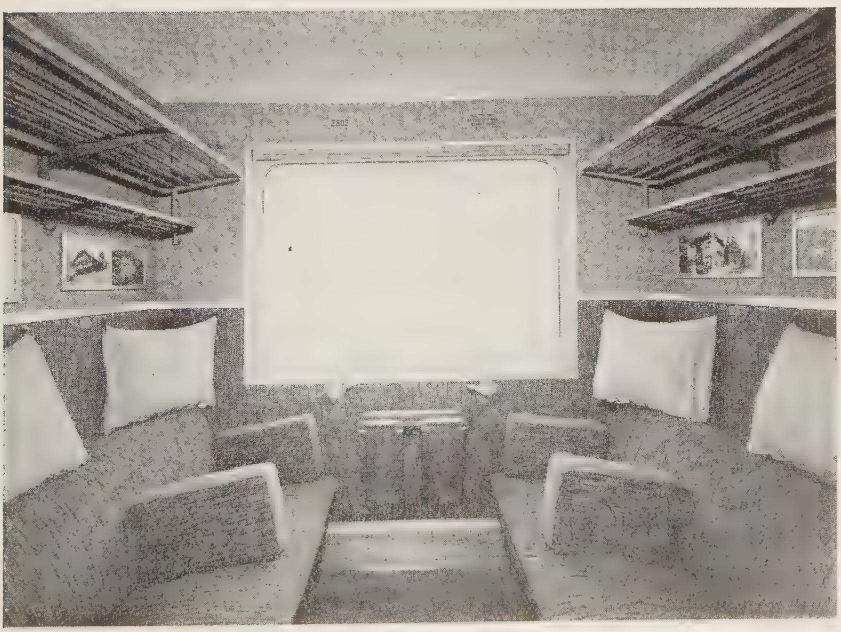


Fig 14. — Interior of second class compartment, AB4ij coach.

Fig. 15.

covering the seats, widths of corridor and seats, and use of antimaccassars, see table 4.

D. 1. — II. Railcars.

The S. N. C. B. provided padded seats in 2nd class; there is not 1st class in railcars. Seat construction is similar to that of carriages.

S. N. C. V. railcars in one-class compartments have single or double seats, without arm rests. The seats are of foam rubber.

In D. S. B. railcars the seats are constructed similarly to carriage seats. Fig 17 shews the seats in a centre corridor railcar, height of back 1 190 mm above the floor.

The types of seats used in S.N.C.F. railcars vary according to wether they are for high-speed, long-distance services, or for the equipment of standard railcars for ordinary services.

De luxe cars have very comfortable seats, with arm and head rests, of types suited to the decoration of the compartments.

2nd class compartments of standard railcars are fitted with reversible seats (according to the direction of travel) with arm and head rests.

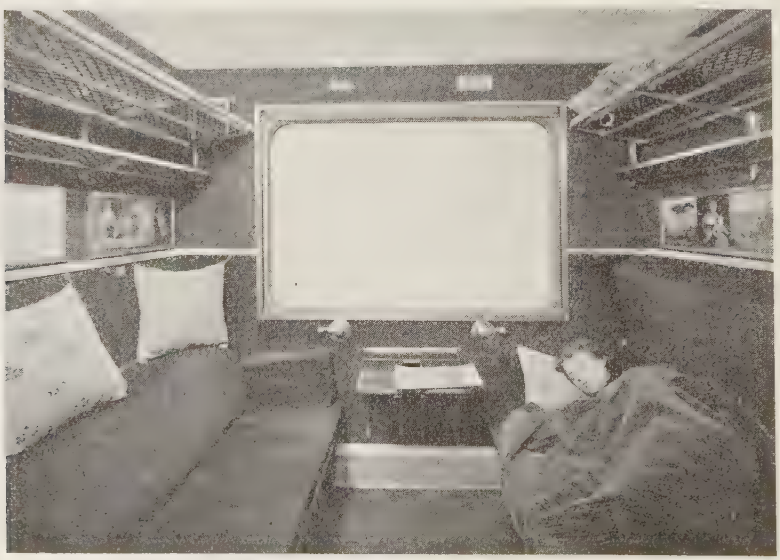


Fig. 16. — *C. F. F.* — Second class compartment.

Third class compartments have standard seats without arm or head rests.

S. G. C. E. railcar seats are of enamelled tubing, with spring cushions and backs with hair overlay. There are hand grips on the seat backs at the corridor side.

The C. F. A. have individual seats in 1st and 2nd class; 3rd class seats are continuous and are upholstered with rubber and springs.

Seat frames in 1st and 2nd class C. F. G. railcars are of steel tubing, chrome and enamel. Upholstery includes springs and leather trimming.

C. F. I. railcars have tip-up seats with springs and hair.

In N. S. B. railcars the seats have springs and hair or alfa fibre; in some vehicles the seats are tip-up type.

The information covering N. S. carriages applies also to railcars.

Convertible seats are not used in railcars.

Table 4 gives additional information.

D. 1. — III. Rail motor coaches.

Seats in S. N. C. B. 2nd class motor coaches are padded. Wood seats are provided in 3rd class compartments, except in 1935 motor coaches, where seats are padded with vegetable hair. This type of padding has not been perpetuated in subsequent cars.

Information provided by the S. N. C. V. concerning railcars applies also to motor coaches.

D. S. B. motor coaches are centre corridor type and the seats are as shewn in fig. 18; height of back is 900 mm above floor.

More recent suburban motor coaches of the S. N. C. F. are fitted : in 1/2 class with seats having straight backs, slightly hollowed, with resilient trimming of the seat and back; in the 3rd class the seats have straight backs, slightly hollowed, with veneered wood seat and back.

In both cases the seats have neither arm nor head rests, but the back is generally sufficiently high to exceed the neck of a seated passenger (upper part 1 060 mm above the floor).

In R. A. T. P. motor coaches seats have the same profile in both classes. They are comparatively narrow so as to increase the capacity of the coach, comfort being the secondary consideration since passengers are mostly in the train for a short time only.

Padding of the seat cushion and the lower part of the seat back is of flat springs of piano wire, carried by coil springs and trimmed with hair end felt.

3rd class express trains of the N. S. B. are provided with fixed double seats (2 × 2 persons) with the angle adjustable and in suburban trains the seats have tip backs, for two or three persons. Trimming, springs, hair or alfa fibre.

The information on N. S. railcars applies also to motor coaches.

With regard to the C.F.R. and E.B.T.B.; reference should be made to the information in Chapter *D. 1. — 1,* on carriages.

Convertible seats are not used in motor coaches.

Supplementary information on seats is given in table 4.

D. 2. Decoration of walls and floors.

D. 2. — I. Carriages.

In S. N. C. B. carriages the decoration of the walls is at present veneered wood, in all classes, but in previous construction solid wood and also steel plate have been used in some cases.

International coaches under construction, and all future stock, will have flooring constructed as in fig. 19 and 20.

In present stock there are some instances of flooring in magnesium cement.

Modern D. S. B. stock has triple walls between compartments of wood veneered from the cornice to the top of the seat back, see Chapter A. 2. 1 and fig. 2; between the cornice and the ceiling the walls are double and consist of Masonite. Metal floors are dealt with in Chapter A. 2-1.

	Side corridor coaches					Centre	
	Width of corridor mm	Number of seats	Width of each seat mm	Distance between seats mm	Length occupied by two facing seats mm	Width of corridor mm	Number of seats
S. N. C. B. (Belgium) :							
1st. cl. International service vehicles	750	3	625	645			
2nd. cl. International service vehicles	750	3	625	535			
3rd. cl. International service vehicles	660	4	498	483			
1st. cl. / 2nd. cl. / 3rd. cl. Internal service vehicles 3)	750	3	625	514		600 1)	2 + 2
						600 2)	2 + 3
S. N. C. V. (Belgium) :							
Single class						550 to 700	
D. S. B. (Denmark) :							
Carriages, 1st. class.	832	3	640	720	2 300		
Carriages, single class	847	4	490	568	1 790		
Railcars, 1st. class . . . . . . 1)	770	3	640	590	2 120		
Railcars, single class . . . . 1)	770	4	480	470	1 700	600	2 + 2
Railcars, single class . . . . 2)						538	2 + 3
Motor coaches, single class						500	2 + 3
S. N. C. F. (France) :							
1st. cl. Main line	700	3	650	549	2 175		
2nd. cl. Main line	700	4	500	570	1 940		
3rd. cl. Main line	700	4	490	510	1 750		
2nd. cl. Suburban or omnibus						620	4
3rd. cl. Suburban or omnibus						450	5
2nd cl. Railcars						400	2 + 2
3rd. cl. Railcars						400	2 + 3
De luxe railcar						400	1 + 2 ou 2 + 2
1st./2nd. cl. Main line motor coach						610	2 + 2
3rd. Main line motor coach						610	2 + 2
1st./2nd. cl. suburban coach						655	2 + 2
3rd. suburban coach						465	2 + 3

corridors.

…lor coaches		Seat coverings	Removable back-covers	Remarks
…nce …een …ts …n	Length occupied by two facing seats mm			
		Blue mohair velour Brown mohair velour Not trimmed	Antimaccassars fixed by studs to the trimming.	1) At waist height, 450 mm between arms rests. 2) At waist height, 480 mm between seats. 3) Also applicable to railcars and motor coaches. 4) Domken fabric in 1935 motor coaches only.
		Blue mohair velour	Antimaccassars.	
0		Brown mohair velour		
5		Not trimmed 4)		
	1 500 1)	Chrome pony hide.		1) All seats in the same direction, 750 mm.
		Gobelin design terry.	Lace antimaccassars and press studs.	1) « Flash » train. 2) Under construction.
		Leather.		
		Gobelin design terry.	— do —	
0	1 700	Leather.		
0	1 700	Leather.		
0	1 590	Leather.		
		Cloth. Cloth.	The backs and head rests are covered with a loose lace cover. This includes binding which loops on to buttons sewn to the back.	1) For stock to be delivered, 1 600 mm. 2) For future stock. 3) In motor coaches of feeder services the seats are of leather.
0		Texoid (art. leather).		
0		Velour and leather.		
	1 800	Cloth or leather.		
	1 500 1)	Texoid.		
	2 000	Cloth or leather.	As for 1st. and 2nd. main line coaches.	
	1 800	Texoid.		
	1 600	Texoid.		
	1 650	Texoid 3)		
	1 500	Texoid.		

TABLE IV. — D. 1. Tri

	Side corridor coaches						
	Width of corridor mm	Number of seats	Width of each seat mm	Distance between seats mm	Length occupied by two facing seats mm	Width of corridor mm	Number of seats
S. G. C. E. (France)							2 + 2
R. A. T. P. (France)							
C. F. A. (Algeria) :							
1st. cl. carriages	700	3			2 150		
2nd. cl. carriages	700	4			1 900		
3rd. cl. carriages	700	4			1 690		
1/2 cl. railcars							2+2 1)
3rd. cl. railcars							2+3 2)
C. F. G. (Tunisia) :							
2nd. cl. railcars							2 +2
3rd. cl. railcars							2 +3
C. F. M. (Marocco) :							
1st. cl. carriages	700	3			2 150		
2nd cl. carriages	700	4			1 900		
C. F. I. (Indo-China) :							
1st. cl. semi-sleeper carriages	e. 650				e. 2 150		
2nd. cl. semi-sleeper carriages	e. 650				e. 2 150		
3rd. cl. semi-sleeper carriages	645				1 525 1)		
1st. cl. carriages	660	3	e. 615	600	2 200		
2nd. cl. carriages	660	3	e. 615	800	2 000		
3rd. cl. carriages	660	4	e. 460	570	1 530		
Railcars						330	2 + 2

and corridors *(Continued)*.

dor coaches				
ance een ts m	Length occupied by two facing seats mm	Seat coverings	Removable back-covers	Remarks
	1 500 1)	Natural leather.		1) All seats in the same direction : 800 mm.
0	1 400	Natural leather.		
		Imitation leather. Cloth. Linoleum.	The loose back covers of cotton fabric with the initials C. F. A. woven in are fixed to seat backs in 1st. and 2nd. class.	1) Individual seats. 2) Bench type seats.
	1 600 1 500	Dark hide. Not trimmed.		
		Red art. leather. Green art. leather.		
	900 2)	Leather. Leather. Leather. Imitation leather. Imitation leather. Imitation leather. Imitation leather.		1) Coupé compartments. 2) Tip-up seats.

TABLE IV. — **D. 1. Tri**

	Side corridor coaches							
	Width of corridor mm	Number of seats	Width of each seat mm	Distance between seats mm	Length occupied by two facing seats mm	Width of corridor mm	Number of seats	c
N. S. B. (Norway) :								
2nd. cl. carriages.	850	3	e. 625	e. 660	2 220	870	1 + 2	e.
3rd. cl, carriages.	850	4	e. 470	—	1 770	540	2 + 2	
3rd. cl. suburban carriages. . . .						520	2 + 3	e.
3rd. cl. rails cars.						—	2 + 3	
3rd. cl. railcars						—	2 + 2	
3rd. cl. motor coaches						560	2 + 2	
3rd. cl. suburban coaches.						550	2 + 3	
N. S. (Holland) :								
Carriages 1st. cl..	690	3	560	700	2 184			
Carriages 2nd cl.	690	3	560	600	2 084			
Carriages 3rd. cl.	690	4	460	560	1 870			
Railcars 2nd. cl..	685	3	525	494	2 000		2 + 1	
Railcars 3rd. cl..						522	2 + 2	
Motor coaches 2nd. cl..		3			2 040		2 + 1	
Motor coaches 3rd. cl..		4			1 640		2 + 2	
C. F. F. (Switzerland) :								
Carriages 1st. cl..	783	3	e. 550	690	2 300			
Carriages 2nd. cl.	783	3	e. 525	690	2 300	652	2 + 1	
Carriages 3rd. cl.						520	2 + 2	e.
C. F. R. (Switzerland) :								
1st. cl.	690	3	485	655	2 115			
2nd. cl.	690	3	485	520	1 900			
3rd. cl.						480	2 + 2	e.
E. B. T. B. (Switzerland) :								

and corridors *(Continued)*.

…lor coaches		Seat coverings	Removable back-covers	Remarks
…ance between …ts …m	Length occupied by two facing seats mm			
…0 …o 510 – – –	2 030 1 670 810 1) e. 1 640 1950 to 1990	Wool cloth, pegamoid or natural leather.	Seats in express trains are fitted with back-covers, fixed by press studs.	 Type 7.
…0 …0 1)	1 990 825 1)	Wool cloth in express trains, buffalo hide or pegamoid in suburban trains.		Type 8. Type 1. Type 105. 1) Tip seats.
    …2	 762 1) 1 600 2 000 1 590	Velour. Velour. Artificial leather. Velour. Artificial leather. Velour. Artificial leather.		1) All seats in the same direction.
 …0 …3	1 910 1 886	Red velour. Velour grey striped. Not trimmed.		
…0	1 500	Velour, plastic or woven fabric. Not trimmed.		
				Modern vehicles are equipped with seats built to the standard C. F. F. design.

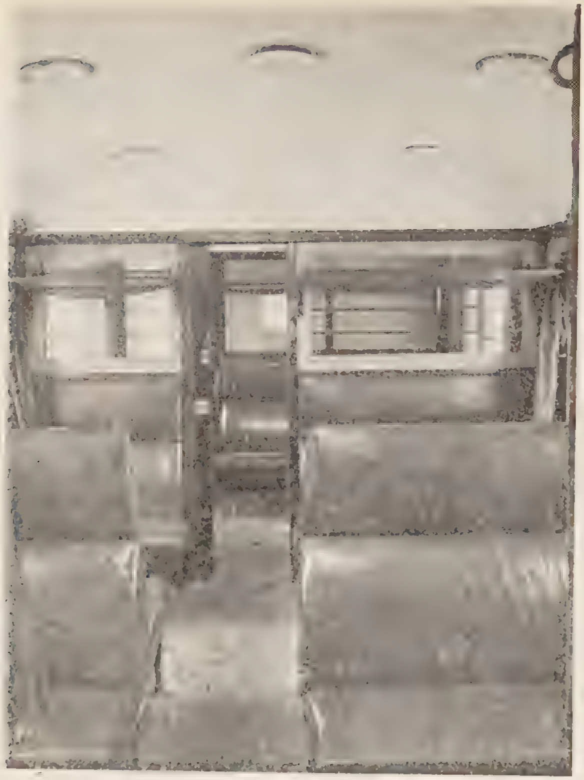


Fig. 17. — *Danish State.* — « Single class » railcar.

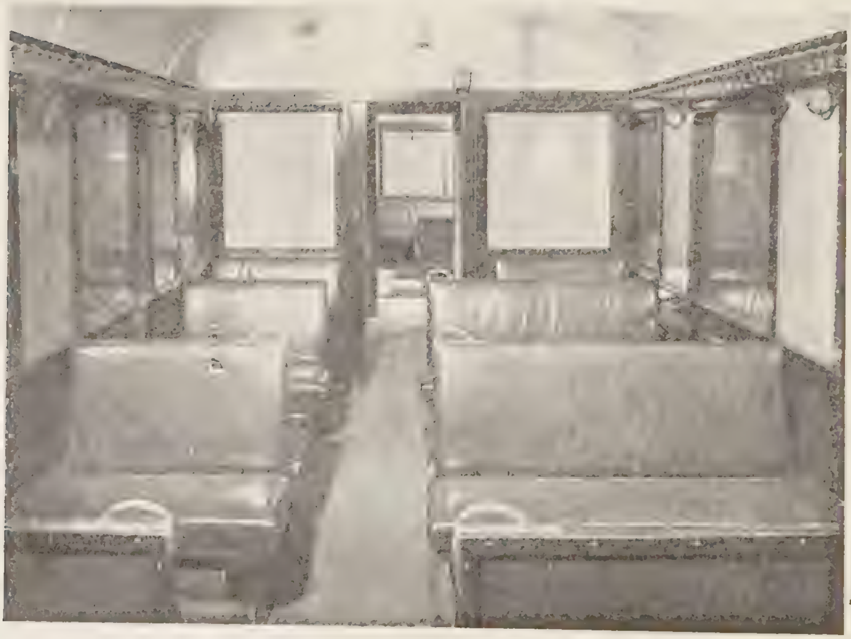


Fig. 18. — *Danish State.* — « Single class » motor coach.

In coaches built before 1943 the flooring is of 30 mm deal covered with Celotex 6 mm thick, and 3.5 mm linoleum in single class and 9.5 mm rubber in first class.

The S. N. C. F. use wall facings in main line coaches as under :

1st and 2nd class : Texoid from floor to cornice. Lacquered panels above the cornice;

3rd class : Lacquered steel panels for the whole wall.

Trials with plastic facings are at present in hand.

Omnibus and suburban vehicles are fitted with :

2nd and 3rd class : Lacquered steel panels for the whole wall.

The floors of main line coaches are trimmed as follows :

1st class : Wool moquette;

2nd and 3rd class : Linoleum.

Omnibus and suburban vehicles are as follows :

2nd and 3rd class : Linoleum.

In C. F. A. carriages, walls are faced with teak friezes, laminated ply, canvas glued to rubberised cloth (roofing). The floor is covered with moquette carpet on linoleum for 1st class, rubberised flooring in 2nd class and linoleum in third class.

Interior facings of walls in C. F. M. carriages are laminated ply or compressed fibreboard. The floor is oak, covered with Celotex, drugget and linoleum.

C. F. I. coaches have wood walls and the floor is linoleum covered.

For interior facing of N. S. B. carriages Rexine or Pegamoid is used with overlapped joints; the floor is covered with linoleum.

In N. S. carriages the walls are of laminated board (inner walls) or faced (outer walls) with plywood. To this is glued a layer of Pegamoid (plastic material) in the 3rd class; or to the lower part of velour, with Pegamoid on the upper part, in the 2nd class

Floors are covered with linoleum.

C. F. F. coach walls are treated as follows :

3rd class : close-jointed wood of about 5 mm thickness, to which is glued 2 mm linoleum.

2nd class : close-jointed wood is covered, up to the waist, with the same velour as the seats, above the waist is a facing of leather cloth.

Trials are in hand with various plastic materials.

The floor is of deal boards, 20 mm thick. It is first covered with a layer of cork, 3 mm thick, which provides thermic insulation then a layer of 4.5 mm linoleum.

In 2nd class compartments corridor floors and the free space between seats are also covered with grey moquette carpet.

In AB4u coaches, the side corridor has a rubber floor covering. The compartments each have a moquette carpet.

The C. F. R. uses wood, or laminated board and lino. for walls and wood and linoleum for floors.

D. 2. — II. Railcars.

In railcars also, the S. N. C. B. use laminated board for wall facing in all classes. In future construction floors will be laid as in figs. 19 and 20.

In existing vehicles, there are some wood floors (railcars for secondary lines), compressed wood floors and magnesium cement floors.

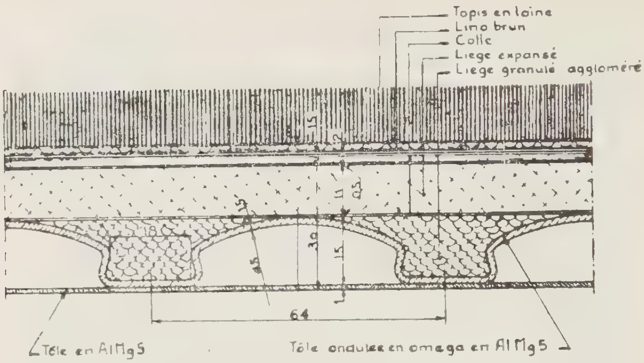
The S. N. C. V. faces walls with processed wood or triplex and floors are of deal boards with ash gratings.

The construction of walls and floors in D. S. B. railcars is similar to that of carriages, see Chapter D. 2. — I.

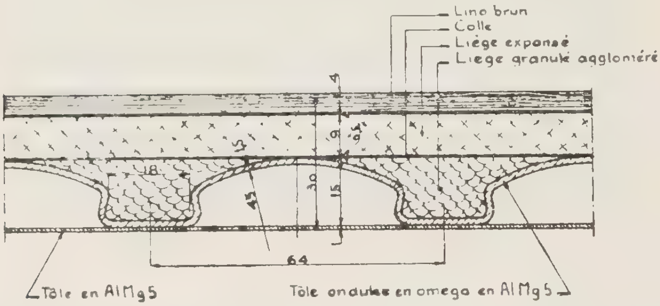
The S. N. C. F. are at present using either aluminium plate or impregnated laminated board reinforced with 0.5 mm aluminium plate for facing walls.

Several railcars have been fitted with Traffolyte plastic panels, with very pleasing and durable results, but having the drawback of being combustible.

Some older railcars are fitted with non-impregnated laminated board; during over-



1st. *class.*



2nd. *class.*

Fig. 19. — *S. N. C. B.* — Floor.

Explanation of French terms :

Tôle ondulée = Al Mg5 corrugated plate. — Tapis en laine = Wool carpet. — Lino brun = Brown linoleum. — Colle = Adhesive. — Liège expansé = Cork matting. — Liège granulé = Granular cork. —

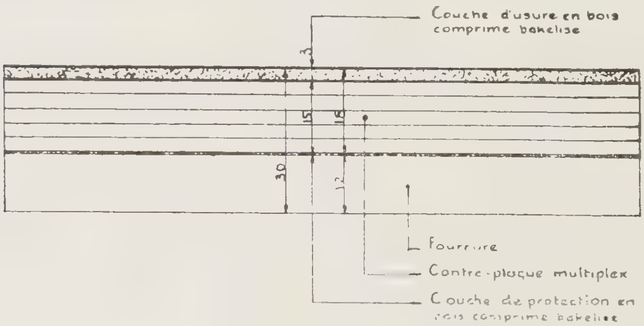


Fig. 20. — *S. N. C. B.* — Floor, 3rd. class.

haul this board is being replaced by alluminium sheet to reduce the risk of fire.

Normally floors are of corrugated steel plate covered with fireproofed laminated board, Isorel or cellular ebonite and linoleum.

To reduce weight, future trailers will have fireproof Ebonite panels, reinforced with aluminium facing on both sides, the panels being covered with linoleum.

In the parts subject to wear, the linoleum is replaced by a polyvynil base plastic (covinite).

Certain older railcars have floors reinforced with aluminium plate; during overhauls, this has been replaced by steel plate, to reduce the risk of fire spreading.

Passenger compartments on the S. G. C. E. are faced with 5 mm O-Koume, finished in natural varnish, with 4 mm laminated ceiling, painted in matt white.

At the bottom of the panels there is a plinth of fluted aluminium.

A laminated board floor of 22 mm thickness is covered with linoleum flooring.

The walls of C. F. A. railcars are not faced; floor trimming is moquette carpet and rubber.

In C. F. G. railcars the walls are faced with strong Isorel and the floors are covered with linoleum.

Compartments of C. F. I. stock have painted aluminium plate for the walls; the floor is wood covered with linoleum.

The N. S. B. faces walls in natural wood, laminated wood in lacquered panels or facings with the joints covered with plastic material; floors are covered with linoleum.

N. S. railcars have the same wall and floor covering as carriages.

D. 2. — III. Rail motor coaches.

As for carriages and railcars, the S. N. C. B. faces walls in all classes with laminated plywood. In future constructions and in the 1950 rail motor coaches, the floors will be constructed as in figs. 19 and 20. In present constructions, a magnesium cement floor is used.

The S. N. C. V. use the same facings as for railcars.

The construction of walls and floors in D. S. B. motor coaches is the same as that for carriages, see Chapter D. 2. — I.

S. N. C. F. motor coaches have all-metal, painted walls. In hauling vehicles the floor is covered with linoleum, and in suburban motor coaches there is a bare terrazzo floor.

The R. A. T. P. has used painted aluminium plate for the walls and magnesium cement for the floors; these materials offering the best resistance to wear, and allowing the repairs to be carried out most easily.

Walls of N. S. B. rail motor coaches have close-jointed facings varnished, or processed wood panels painted; the floor being covered with linoleum.

The N. S. use in motor coaches the same materials as mentioned for railcars and carriages.

The C. F. R. use wood, laminated ply, or linoleum for walls and wood and linoleum for the floors.

E. B. T. B. coaches have inlaid wall facings in third class and special trimming material in 2nd class; the floor is oak in third class and deal in second class, covered with 10 mm cork.

D. 3. Arrangement of seats, compartments, doors, etc.

D. 3. — I. Carriages.

In modern S. N. C. B. the following arrangements are standard :

a) outer doors open outwards;

b) intercommunication doors (vestibules) are sliding;

c) centre corridor for internal service vehicles, except in 1st class which has a side corridor;

d) side corridor in international stock with sliding compartment doors. Swing doors in corridors to segregrate smoking and non-smoking sections;

Fig. 21. — *Danish State*, suburban « single class » coach.

e) transverse partitions reduced to a minimum in internal service vehicles; partitions between smoking and non-smoking sections with sliding doors;

f) hinged doors to toilet compartments.

D. S. B. modern stock has hinged doors, opening outwards, and sliding doors between corridor and compartments. Doors in the side corridor are hinged and interior doors in centre corridor coaches are usually hinged but in some are sliding. In modern stock for suburban services there are in each vestibule two hinged doors opening outwards from the side wall, see fig. 21.

On S. N. C. F. main line stock, compartment doors and also the doors to the gangways, are sliding, whilst the corridor doors, toilet compartment doors and the access doors at each end of the coach are all hinged.

In omnibus coaches all doors are sliding, except those to the toilet compartments and intercommunication gangway doors.

The C. F. A. have sliding doors to compartments.

In C. F. M. and C. F. I. coaches, doors between compartments and side corridors are sliding, access and corridor doors being hinged.

Fig. 22. — Double entrance door, centre corrido[r] C4u coach.

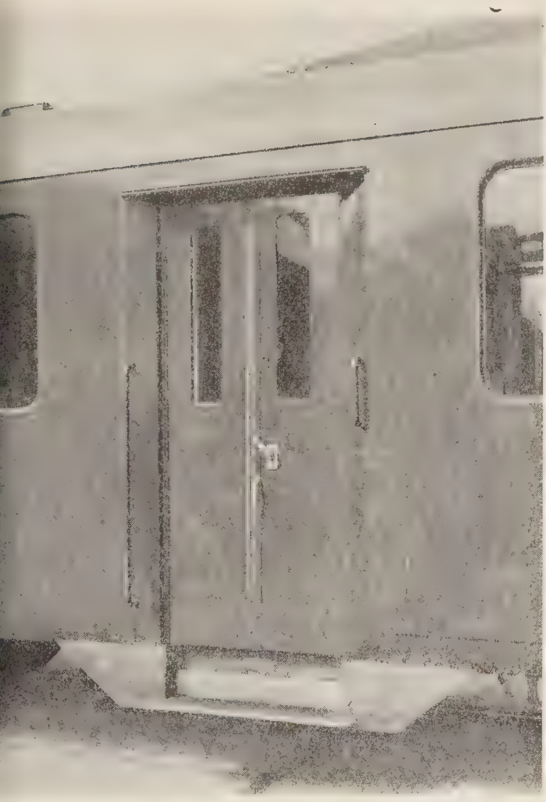


Fig. 23. — Entrance door, B4ij coach

In N. S. B. side corridor coaches, the doors between the corridor and the compartments are sliding, doors in corridors hinged. The outer access doors are hinged, normally opening outwards. In some centre corridor coaches the access doors open inwards, and doors between compartments are sliding; one type of third class has three vestibules, the centre one having sliding access doors.

N. S. side corridor coaches have hinged access doors opening outwards. Doors between corridors and compartments, and gangway doors are sliding. Doors in corridors are hinged.

Interior doors of C. F. F. coaches are all sliding.

Outer doors are folding; they are located between the bogies, which allows the floor level in the centre compartment to be lowered to a level of 1 metre above rail, and avoids the need for steps, see figs. 22 to 24.

C. F. R. coaches are provided with folding outer doors, located in the centre of the vehicle; most interior doors are sliding.

Amongst the Administrations dealt with, only the D. S. B. and N. S. B. have compartments specially reserved for women with young children.

In six single-class coaches of the D. S. B., put into service in 1950, two of the nine compartments are reserved for women with children under four years of age. A toilet compartment with access from the side corridor is reserved for passengers in the two

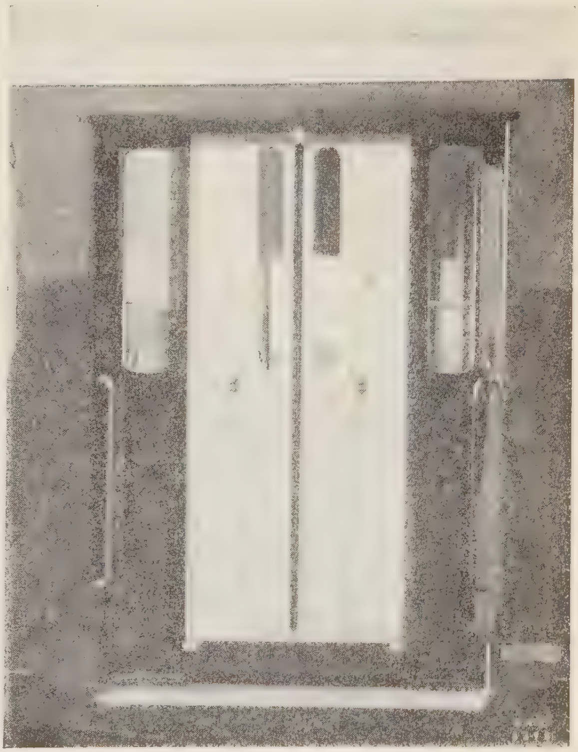


Fig. 24. — Entrance door serie B4u carriage.

compartments; it is provided in addition to the usual commodities, a hand basin with hot and cold water, a table for babies, a rustless steel cabinet, heated for drying of pillows and similar articles, and a waste bin. The walls are of « Warerite ». In the two compartments the luggage racks are also designed to hold small children.

As regards the N. S. B., 15 modern 3rd class carriages have been provided with children's compartments reserved for women with young children. There is, for example, a small table for infants, hot and cold water etc.

The luggage racks are also designed specially to hold baskets etc. in which infants can sleep. There are safety nets in front of the racks.

The layout of seats, space reserved for hand luggage and accessories for the use of passengers are shown in tables 5 and 6.

D. 3. — II. Railcars.

The standardised arrangements for S. N. C. B. railcars are as follows :

a) outer access doors opening outwards, or leaf doors;

b) intercommunication (gangway) doors sliding;

c) central corridor;

d) transverse partitions reduced to a minimum for internal service vehicles; partitions between smoking and non-smoking sections, with sliding doors;

e) hinged doors to toilet compartments.

S. N. C. V. railcars are provided with a single compartment and folding outer doors.

Most outer access doors of D. S. B. railcars are sliding, interior doors hinged or sliding.

In S. N. C. F. railcars, the most usual arrangement at present is :

a) a large central compartment occupying the full width of the coach;

b) small end compartments also occupying the full width of the vehicle.

These compartments are provided with vestibules to which there are entrances from both sides of the vehicle. The access doors are hinged on existing vehicles, but cars at present under construction will have sliding doors. Compartments are generally separated from the vestibules by glazed panels over the seat backs.

Where there are two adjoining compartments of different classes they are separated by a plain partition with a hinged door, also plain, which can be locked by a Berne key.

The S. G. C. E. uses sliding doors to the entrance vestibule and swing doors in the compartment partitions.

In C. F. A. railcars the doors are mostly hinged.

All doors of C. F. G. railcars are hinged, opening inwards.

The outer access doors of C. F. I. cars are hinged and open inwards; interior doors are sliding or hinged.

Most doors of D. S. B. railcars are hinged, the outer access doors opening inwards.

The N. S. railcars have both sliding and hinged doors, the latter opening outwards; interior doors are preferably sliding.

Compartments reserved for women with young children are not provided in railcars.

The layout of seats etc. in railcars is shown in tables 5 and 6.

D. 3. — III. Rail motor coaches.

The standard arrangements in S. N. C. B. motor coaches is as follows :

a) outer access doors of leaf type;

b) intercommunication (gangway) sliding doors;

c) central corridor;

d) transverse partitions reduced to a minimum for internal service vehicles; partitions between smoking and non-smoking sections with sliding doors;

e) hinged doors to toilet compartments;

S. N. C. V. motor coaches as the railcars have a single compartment and folding

outer doors. Outer doors of D. S. B. motor coaches are sliding, operated by compressed air. Interior doors are sliding or hinged.

In regard to S. N. C. F. motor coaches, the information given in Chapter D. 3 — II. on railcars applies also.

Access doors of R. A. T. P. coaches are of two sliding conjugated leaves.

N. S. B. suburban stock has sliding outer passenger-access doors, the interior doors being sliding or hinged. Express motor coaches have hinged access doors opening inwards; most interior doors are sliding.

The N. S. motor coaches have sliding access doors. Most interior doors are also sliding.

Outer access doors of C. F. R. vehicles are folding and interior doors generally sliding.

Compartments reserved for women with young children are not provided in motor coaches.

The layout of seats etc. in motor coaches is shewn in Tables 5 and 6.

D. 4. Arrangement of toilet compartments.

The principal information provided by Administrations on toilet compartment fittings is summarised in Table 7.

E. STABILITY OF RUNNING (TYPE OF BOGIES AND SUSPENSION).

E. 1. Bogie vehicles.

E. 1. I. Carriages.

Apart from some bogies of various types, all S. N. C. B. carriages are mounted on Pennsylvania type bogies, see fig. 24.

The S. N. C. V. and D. S. B. also use Pennsylvania type bogies.

Apart from sets mounted on pneumatic tyres, which have a specially designed bogie, modern vehicles of the S. N. C. F. are all mounted on Pennsylvania type bogies, having a primary suspension of helical springs and a secondary one of laminated springs.

At the same time, mention may be made of trials which are being undertaken with a new bogie, known as type Y-20. which has been designed for speeds of 150-160 km/h (96-100 m.p.h.), two prototypes of which have been built in the Works. This bogie, shewn in fig. 25, is similar in some respects to the 1946 bogie of the Chicago, Milwaukee, St. Paul and Pacific Railroad, but differs from it fundamentally, however, by the integral application of the weight to the ends of the swing bolster by the use of manganese steel rubbing blocks.

In this particular arrangement it differs from the normal Pennsylvania bogie, as it also does in the following points :

a) second stage suspension has helical springs conjugated with hydraulic shock absorbers;

b) transverse suspension is obtained by the lateral flexibility of the second-stage helical springs, this suspension also being controlled by hydraulic shock absorbers;

c) there is a rigid link, without play, between the stages of suspension, by the use of resilient articulated rods, silent-bloc type.

Trials of this bogie have so far been satisfactory and are being continued.

All C. F. A. carriages are fitted with Pennsylvania type Y2 R bogies, with light Lesquin type monobloc frame.

C. F. M. bogies are Pennsylvania Y2 R type, with cast steel monobloc frame with swing bolster of cast steel and double equalisers of plate.

The axles fitted are a type standardised by the S. N. C. F. and have S. K. F. roller bearing boxes. The opposed leaf and the helical springs are also of a type standardised by the S. N. C. F.

C. F. I. bogies are of Pennsylvania type

TABLE

	Arrangement of seats			
	I. Carriages	II. Railcars	III. Rail motor coaches	I. Carriages
S. N. C. B. (Belgium)	Facing.	Facing.	Facing.	Racks of perforated plate only; two type longitudinal transverse.
S. N. C. V. (Belgian Light Railways)		Same direction.	Same direction.	
D. S. B. (Denmark)	Facing.	Facing.	Facing.	Modern side corridor vehicles have pa and umbrella racks above the seats. Ce corridor coaches have net racks arran longitudinally on the side walls, above seats.
S. N. C. F. (France)	Facing.	In general, the seats are facing and not reversible. Some types of railcars and motor coaches have reversible seats.		1) In side corridor main line coaches, pa can be placed on racks over the seats and necessary, under the seats. 2) In pneumatic-tyred main line coac hand luggage is placed on longitudinal ra reaching to the cornice and in lockers at ends of each vehicle. 3) In omnibus carriages transverse racks arranged on columns above each seat. 4) In suburban coaches, the racks are gitudinal, at the level of the cornice.
S. G. C. E.		Facing.		
R. A. T. P.			Facing.	

3. **Furnishing.**

erved for hand luggage				
Depth of parcel racks mm	II. Railcars	Depth of parcel racks mm	III. Rail motor coaches	Depth of parcel racks mm
317 363	Racks of perforated plate only ; two types: longitudinal transverse.	317 363	Racks of perforated plate only; longitudinal in 1935, 1939 and 1946 types; transverse in 1950 type.	317 362
—	Under the seats.	—	Under the seats.	—
400	As for centre corridor carriages. In « flash » trains the net racks are usually longitudinal.	400	As for centre corridor carriages.	400
405 — — 456	Transverse racks over the seats. In former cars the racks were longitudinal along the sides, but capacity was much too small. The average space required on the rack for luggage per seated passenger is : width 0.45 m, depth 0.35 m, height 0.40 m. Further the type of seat used in normal railcars allows for fairly large packages to be placed below if there are no heating appliances to obstruct them.	350	Motor coaches on feeder services have the same arrangement as omnibus carriages. Suburban motor coaches have the same arrangement as suburban carriages.	— 456
	Longitudinal; polished aluminium brackets and perforated plate, Metro type.	—		
	—		Racks 300 × 450 mm over each seat.	300

TABLE V

	Arrangement of seats			
	I. Carriages	II. Railcars	III. Rail motor coaches	I. Carriages
C. F. A. (Algeria)	Facing.	Facing.		Racks above seats, across full width compartment, 1 800 mm from floor; sm rack below net rack.
C. F. G. (Tunisia)		Facing.		
C. E. M. (Marocco)	Facing.			Net racks are put above the seats.
C. F. I. (Indo-China)	Facing.	Same direction.		Net racks, 2 × 1 800 mm per compartme
N. S. B. (Norway)	Facing.	In some types there are reversible (same direction) seats, in others fixed facing.	Express trains, facing; same direction (reversible) in suburban.	Racks on side walls and transverse partitio
N. S. (Holland)	Facing.	Generally facing, sometimes same direction.	Facing.	Net racks and umbrella racks over the sea
C. F. F. (Switzerland)	Facing.			Two-stage racks, one for small articl umbrellas, hand bags etc., the other for valis suitcases, etc.
C. F. R.	Facing.		Facing.	Racks, 830 mm long.
E. B. T. B.			Facing.	

Furnishing *(Continued)*.

pace reserved for hand luggage

	II. Railcars	Depth of parcel racks mm	II. Rail motor coaches	Depth of parcel racks mm
	Net racks.	—		—
	Net racks; luggage can be put under seats.	300		—
	Net racks, 2 × 7 400 mm.	300		
ox.	Net racks on side and end walls. Express trains also have a space near the vestibule.	400 approx.	Racks on the side wall.	350-400
	Net racks over the seats.	410	Net racks over the seats.	410
			Racks 830 mm. long.	360
			Racks above and full length of seats.	

TABLE VI. — **D. 3. Trimmings.** — Access

—	I. — Carriages										I	
	Portable tables	Ashtrays	Coat-hangers	Photographs	Mirrors	Arm-rests	Blinds	Curtains	Thermometers		Portable tables	Ashtrays
S. N. C. B. (Belgium)												
International service :												
1st. class	×	×	×	×	×	×	×	—				
2nd. class	×	×	×	×	×	×	×	—				
3rd. class	×	×	×	—	×	—	—	×				
Internal service :												
1st. class	×	×	×	×	×	×	×	—				
2nd. class	×	×	—	—	—	—	×	—			×	× 1)
3rd. class	×	×	—	—	—	—	—	×			×	× 1)
S. N. C. V. *Belgian Light Railways*											×	
D. S. B. (Denmark)												
1st. class	×	× 1)	×	—	2)	×	—	×	—		×	× 1)
Single class	×	× 1)	×	—	2)	—	—	×	—		× 3)	× 1)
S. N. C. F. (France)												
Main line vehicles :												
1st. class	×	× 1)	×	×	×	×	×	—				
2nd. class	×	× 1)	×	×	×	—	×	—				
3rd. class	×	× 1)	—	×	×	—	×	—				
Omnibus and suburban vehicles	—	× 1)	—	—	—	—	×	—			2)	×
R. A. T. P. (France)												
C. F. A. (Algeria)												
1st. and 2nd. class	×	×	×	× 1)	×	—	×	×			×	×
3rd. class	—	—	×	—	—	—	×	×				

ded for the passengers.

…cars			III. — Rail motor coaches.								Remarks
Mirrors	Blinds	Curtains	Portable tables	Ashtrays	Coat-hangers	Photographs	Mirrors	Thermometers	Blinds	Curtains	
	×	—	×	× 1)					×	—	1) Smoking section.
	—	×	×	× 1)					—	×	
			×		×						
2)	—	×									1) Smoking compartments. 2) In corridors. 3) Partly.
2)	—	×	—	× 1)	×	—	—	—	—	×	
	× 3)	× 4)	—	× 1)	—				×	—	1) Smoking compartments. 2) In de luxe railcars portable tables, allowing the serving of light meals, etc., can be fitted between the seats. 3) In former railcars. 4) In new railcars.
											Métropolitan operation only.
×	×	×									1) Also in railcars.
—	×	×									

TABLE VI. — **D. 3. Trimmings. — Accesso**

—	I. — Carriages										II.	
	Portable tables	Ashtrays	Coat-hangers	Photographs	Mirrors	Arm-rests	Blinds	Curtains	Thermometers		Portable tables	Ashtrays
C. F. G. (Tunisia)												×
C. F. M. (Morocco)	×	×	×	×	×		× 1)	× 2)				
C. F. I. (Indo-China) Single class 1st. and 2nd. semi-sleepers	×	×					×					
N. S. B. (Norway)												
1st. class	×	×	×		×		×		×			
2nd. class	×	×	×	×	×		×		×			
3rd. class	×	×	×	×	×		×		× 2)		×	×
Suburban		×	×				×					×
N. S. (Holland) 1st., 2nd., 3rd. class	×	× 1)	×	×	×	—	×	—			×	×
C. F. F. (Switzerland) 1st., 2nd., 3rd. class	×	× 1)	×	×	× 2)	—	×	—	×			
C. F. R. (Switzerland) 1st, 2nd and 3rd class	×	×	×	×	×	—	—	×	×			
E. B. T. B. (Switzerland)												

vided for the passengers *(Continued)*.

ailcars				III. — Rail motor coaches.								
hotographs	Mirrors	Blinds	Curtains	Portable tables	Ashtrays	Coat-hangers	Photographs	Mirrors	Thermometers	Blinds	Curtains	Remarks
		× 1)										1) Also venetian shutters.
												1) In front of the movable light. 2) In front of the fixed lights on the corridor side.
		×										
	× 3) × 3)	×	 ×	×	× ×	× ×		× 3) × 3)		×	 ×	1) Sleepers only (10-11 compartments with two seats, 1st. class passengers can travel singly) second class arranged for two. 2) Sleepers only. 3) Toilet compartments only.
	×	×	—	×	×	×	×	×		×		1) Smoking compartments only.
												1) Smoking compartments only. 2) 1st. and 2nd. class compartments of side-corridor vehicles only.
				×	×	×	×	×	×	—	×	
												As for the C. F. F.

TABLE VII. — **D. 3. Trimmings**

	General description	Wall covering	Floor covering	Wa
S. N. C. B. (Belgium)	Porcher hopper of refractory earthenware with seat and cover. Pedal-operated flush and flap opening. Behind the hopper is a deodourising container. Coldwater wash-basin with regulated tap delivery, hand rails, soap-container and towel and (except in 3rd. class internal service vehicles) coat hanger, mirror and water-jug (international vehicles).	Oxidised light alloy.	Rubber tiles with edges raised to form a plinth.	Yes.
S.N.C.V. (Belgium)	No toilet compartments.	—	—	—
D. S. B. (Denmark)	Toilet compartments have W. C. and porcelain washbowl, mirror, hand rail, coat hanger, soiled towel basket and — in 1st. class — a stainless steel shelf.	Hartex 3.5 mm thick with aluminium sheet 1 mm thick. Walls white enamelled.	« Durac » magnesium cement	Yes, for W. C washbowl. Main line «flash» trains Suburban c and railcars.
S. N. C. F. (France)	*Carriages* : Compartment at each end with direct discharge W. C. with hinged seat and cover; water flush; corner wash basin with regulated tap delivery. Stainless steel shelf and mirror above the washbowl, hat and coat hook and hand rails. In addition, to the W. C. compartment, modern main line S. N. C. F. coaches have at each end a toilet compartment with wash basin, regulated tap supply and stainless steel shelf. The walls and floor are similar to the W.C. compartments.	Enamelled metal walls.	Mosaic floor with large central drain.	Non-drinking tank feeding W. C. and bowl.
	Railcars : The toilet compartment has all the usual fittings, W. C., washbasin, mirror and coat hanger. Ventilation is effected by a blower and in addition the W. C. chute has a deflector plate at the lower end.	Walls painted white, easily washable.	Mosaic floor, raised about 50 mm at the walls.	Water tank ided for W. and washbo
	Motor coaches. — Same as railcars.	— do —	— do —	— do

Arrangement of lavatories.

tanks		The toilet compartments are provided with				
Capacity	Heating in winter	Soap	Towels	Toilet paper	Urinals	1) Steps taken to keep lavatory floors dry. 2) Cleaning.
250 in 1,2 or 3 capacities	Yes, to avoid freezing.	Yes, but in internal service vehicles there is no soap or towels provided in 3rd. class.		Yes.	No.	1) Drains and outlet holes in the flooring. 2) Daily washing of hoppers and floors by swilling. In summer the earthenware is also rinsed with creoline.
—	—	—	—	—	—	—
450 250	1st. class toilets have hot and cold water.	Liquid soap dispenser	Paper towels.	Yes.	No.	1) The floor inclines slightly to two outlet holes. 2. Soap and water washing of floors and walls, if necessary hoppers also with warm soda; hopper disinfected with Izal.
430	Water is warmed in winter either by steam or electricity.	Liquid soap push-button dispenser	Linen hand-towel on roller.	Yes.	No.	1. Generally it is preferred to drain water which may soil the W. C. floor by inclining the mosaic about 1 % from the walls to a central drain. 2) Cleaning and polishing products are used for partitions. These are paste emulsions with a petroleum solvent base and have a 20 % wax polishing content. Disinfectant deodourising products are sprayed in the toilet compartments before each journey. These are Phenol and saponifiable base products, with a lavender or citron odour.
150	Water not heated in winter.	— do —	Linen towels.	Yes.	No.	
250	Water is heated in winter.	— do —	— do —	Yes.	No.	

TABLE VII. — **D. 3. Trimmings.** —

	General description	Wall covering	Floor covering	Water
S. G. C. E.	No toilet compartments.	—	—	—
R. A. T. P.	No toilet compartments.	—	—	—
C. F. A. (Algeria)	Seats, wash basins, taps and soap containers are different in 3rd. class. 1st and 2nd. classes are more fully equipped than 3rd. One parcel rack and one corner table.	Vitreous plate.	Tiles.	Yes.
C. F. G. (Tunisia)	Toilet compartments in the vestibules;coat hangers provided. 1st. and 2nd. classes have hinged seats; 3rd. class have part seats secured to the hopper.	— do —	Ceramic tiles.	Yes, common to W. C. and washbowl.
C. F. M. (Marocco)	Each 1st. and 2nd class W.C. has a glazed earthenware hopper with hinged seat, glazed earthenware washbowl with pedal-operated supply, shelf of ceramic earthenware, 2 coat hangers, 2 mirrors in 1st. class, 1 in 2nd. class. Chanard blower ventilator.	Plate.	3 mm galvanised steel plate, covered with 2 mm lead on a concrete bed, reinforced with metal mesh and glazed earthenware tiles.	Yes.
C. F. I. (Indo-China)	*Carriages.* 1st. and 2nd. class have a toilet compartment with shower, washbowl, mirror, soap box and W. C. compartment with washbowl, mirror and soap box. In 3rd. and 4th. class there is only a W. C. compartment.	White painted plate.	Earthenware tiles.	Yes.
	Railcars: 1 W.C., 1 washbowl, 1 liquid soap container, 1 towel rack, 1 mirror, 1 coat hanger, 1 toilet paper holder.	Enamelled plate.	Mosaic.	Yes.

Arrangement of lavatories *(Continued)*.

anks		The toilet compartments are provided with			Urinals	1) Steps taken to keep lavatory floors dry. 2) Cleaning.
Capacity	Heating in winter	Soap	Towels	Toilet paper		
—	—	—	—	—	—	—
—	—	—	—	—	—	—
320	Yes.	Yes.	No.	Yes.	No.	1) The floor inclines slightly to the outlet hole. 2) Pumice dust, spirits of salts and ozopenthine are used.
100	No.	Yes.	Towel holders	Yes.	No.	1) Normal drainage from the floor is provided. 2) For cleaning, Teepol (Shell product); for disinfectant, Cresil scour.
300	No.	Yes.	Rack for linen hand towels	Yes.	No.	
300 100	— —	Yes, 1st. and 2nd. classes only		Yes. —	— —	1) Drains or outlet holes. 2) Cresyl and water for cleaning.

TABLE VII. — **D. 3. Trimmings.** —

	General description	Wall covering	Floor covering	Water
N. S. B. *(Norway)*	*Carriages* : Partitions and ceilings are painted white and the mirror frame is teak or oak, polished. The door is framed, faced with laminated board, the inner side painted white. All fittings are chromed. The washbowl is white earthenware. In addition there is a mirror, a box for soiled paper towels, coat hanger and ashtray. Window lifts — lower part fixed. Hardboard panels; hidden surfaces are soaked in linseed oil before fitting. Between the wooden wall and the hardboard panel a bedding of 1 mm thick asphalted paper.	See general description.	Rubber.	No flushing of W.C. s.
	Railcars : have a toilet compartment of an area of 1.0 — 1.3 m².	Laminated or hardboard panels, white enamelled.	Rubber.	For washbowls and — in express trains — for W.C
	Motor coaches : Toilets of motor coaches are 1.0 — 1.3 m². They have windows (the upper part adjustable) of obscured glass.	Hardboard panels, painted white. —	Rubber.	For washbowl and W. C. flush in express trains. For washbowl in suburban stock.
N. S. *(Holland)*	—	Aluminium, painted white.	Lead, with asphalt tiles.	For W. C. and washbowl.
C. F. F. *(Zwitzerland)*	Each coach has two toilet compartments, at the ends.	Panelled with « Renovite » (a type of « Masonite ») 3.5 mm thick. Outer surface is stoved enamel for hardness and resistance to wear.	Wood floor with rubber covering, raised edges. This type has not given good results in service and is being replaced in new coaches by stone tiles.	— do —
C. F. R. *(Zwitzerland)*	W. C. hopper, washbowl, mirror, water-jug and coat hanger.	Paper board.	Ceramic tiles.	Yes.
E. B. T. B. *(Zwitzerland)*	Same equipment as is provided by the C. F. F.	—	—	—

gment of lavatories *(continued)*

		The toilet compartments are provided with				
acity	Heating in winter	Soap	Towels	Toilet paper	Urinals	1) Steps taken to keep lavatory floors dry. 2) Cleaning.
for ch bowl	No.	Yes.	Paper towels.	Yes.	No.	1) No special measures. 2) Normal cleaning and scouring, soap and water.
ilcars 0 ress	No.	Yes.	Linen or paper towels.	Yes.	No.	— do —
ins 0	No.	Yes.	Paper towels at present.	Yes.	No.	— do —
500	Yes, carriages and motor coaches.	Yes.	Paper towels.	Yes.	Yes - quadruple railcars, with water flush.	1) W. C. floors have a drainage hole. Floor inclines inwards towards this outlet. 2) Phenol.
0	Yes, by a storage radiator, 700 W, in a tank outlet. However, the tanks are emptied during very cold spells.	Yes.	— do —	Yes.	No.	1) No special measures, apart from frequent cleaning. Floor has a drain for releasing swillage water. 2. For cleaning walls, floors and hopper warm water is used with additions of proprietary chemicals « Issib » and « Homogen ».
0	Emptied in winter.	Yes.	— do —	Yes.	No.	—
-	No.	—	—	—	—	Toilet compartments cleaned using liquid soap only.

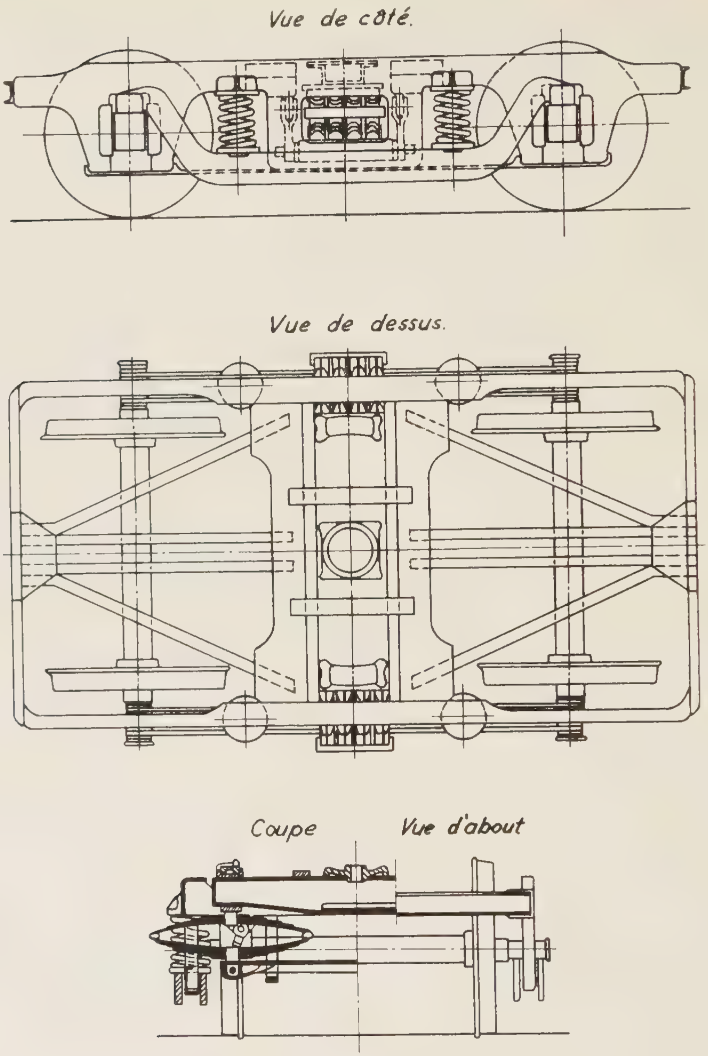


Fig. 25.

Explanation of French terms : Vue de côté = Side view. — Vue de dessus = Top view. — Section = Coupe — Vue d'about Front-end view.

and bogies without a swing bolster are not used.

Fig. 26 shews the construction of a bogie used by the N. S. B. for a modern timber-bodied vehicle, and the diagram, fig. 27, shews the bogie of the latest steelbodied coaches.

On the N. S., Pennsylvania type carriage bogies are used.

The C. F. F. central corridor coaches are all equipped with S. W. S. type bogies as shewn in the diagram in fig. 28, and the photograph, fig. 29.

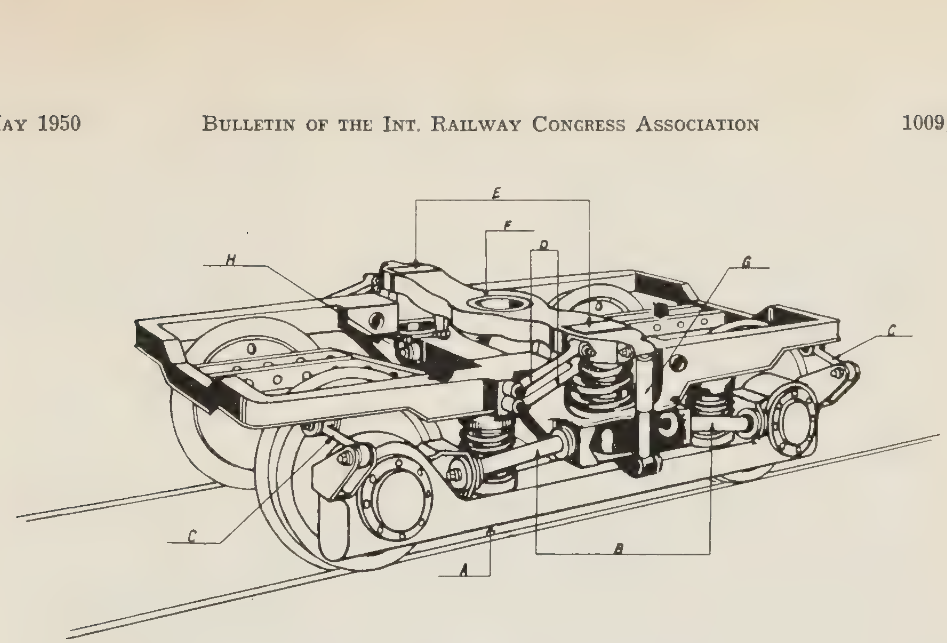


Fig. 26. — General view of bogie Y20.

A Compensating girder.
B Longitudinal connecting-rods linking frame of bogie with compensating girders.
C Transversal connecting-rods linking frame of bogie with compensating girders.
D Longitudinal connecting-rods linking swing bolster with frame of bogie.
E Bolsters.
F Pivot boss with rubber ring.
G Vertical telescopic hydraulic shock-absorbers.
H Rotating hydraulic shock-absorbers restricting transversal movement of swing bolster.

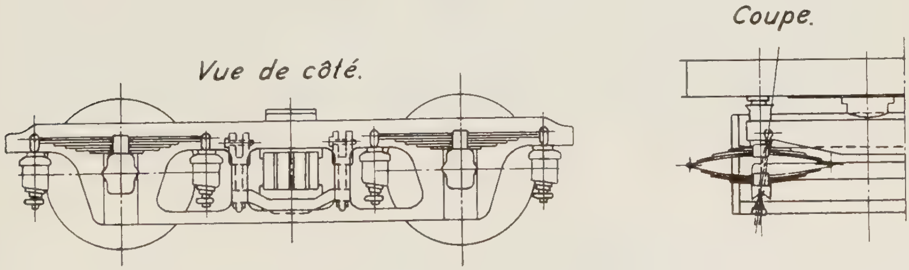


Fig 27.

Explanation of French terms : Vue de côté = Side view. — Coupe = Section.

The principal characteristics of this bogie are :

The primary suspension (axle/bogie) is by helical springs situated on each side of the axlebox. The secondary suspension (bogie/body) is by two laminated springs linked to the bogie frame by inclined links. These are duplicated by two additional laminated springs which begin to bear when the load reaches a certain figure so as to avoid too great a deflection of the main springs under heavy loading.

The full weight of the body is on the centre pivot. It is transmitted to the springs by the swing bolster which has a lateral play of 45 mm on each side. Side bearings

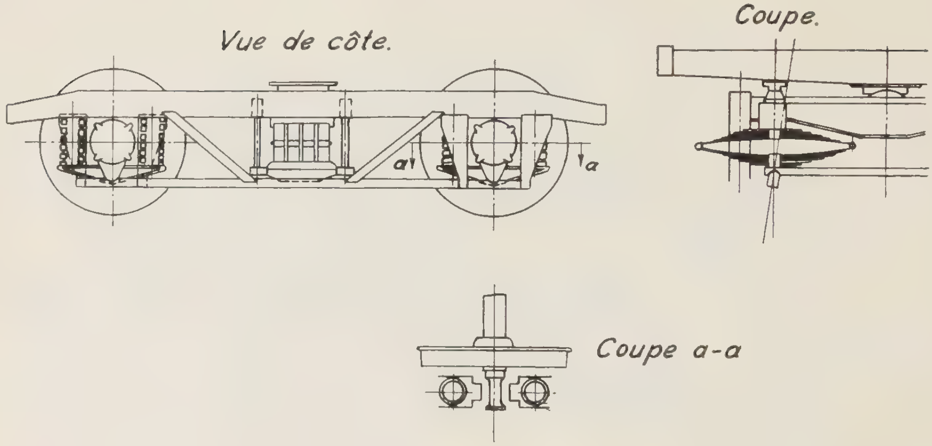


Fig. 28.

Explanation of French terms : Vue de côté = Side view. — Coupe = Section. — Coupe *a-a* = Section *a-a*. — Vue de côté = Side view. — Coupe = Section.

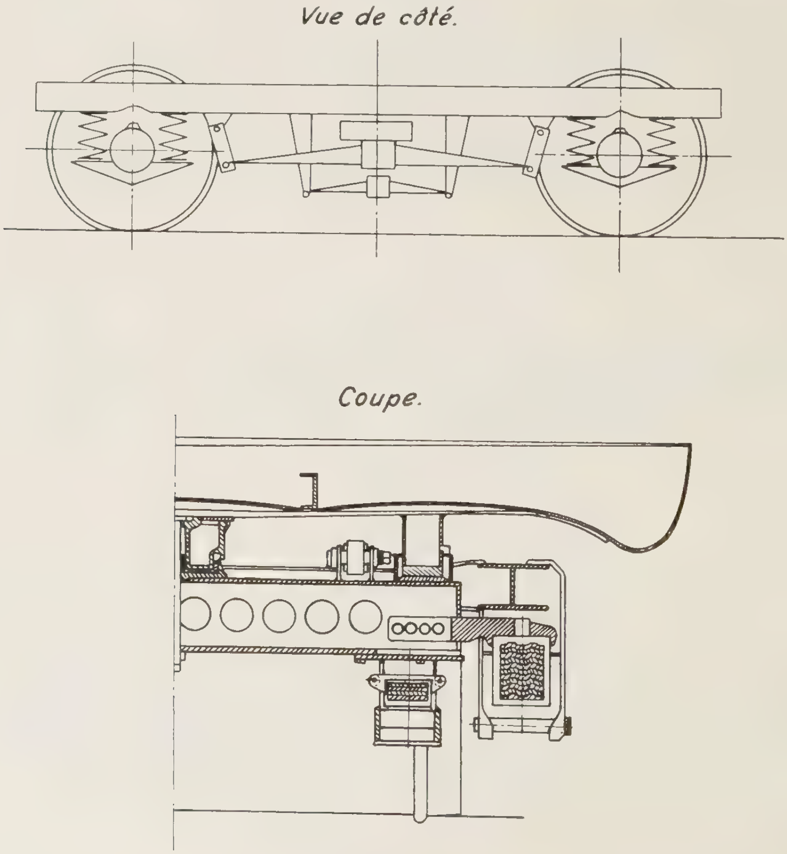


Fig. 29.

with a normal play of 1 mm check the rolling of the body.

A first series of eight side corridor coaches, series AB4ü, has been fitted for trial with torsion bar bogies, type I SIG, having the following main characteristics :

the body rests on side rollers connected by levers to a set of torsion bars located inside the bogie frame and anchored to the front headstocks of the bogie frame. The frame is then suspended on the axleboxes by links fixed to the torsion bars seen outside the bogie (see fig. 30). There is therefore no swing bolster. The bogie frame replaces it, since it is able to oscillate laterally on the rods which link it to the axleboxes. The centre pivot serves as a link between the body and the bogie and is subjected only to the horizontal directional and braking forces.

The last vehicles of the AB4ü series, put into service in 1947-1949, have type II SIG bogies as shewn in fig. 31, with the following features :

the body rests on a swing bolster linked by two inclined rods to the levers of four torsion bars of the secondary suspension. A central pivot connects the bogie frame to the swing bolster and thus transmits the directional and braking forces from the bogie to the body.

The primary suspension is made up of eight torsion bars located transversally, bearing on the axleboxes by articulated levers and on the frame by silent-blocs.

These torsion bars are anchored to the bogie frame solebars.

The type I SIG bogie has no real swing bolster (see paragraph above). Results obtained with this bogie have been excellent

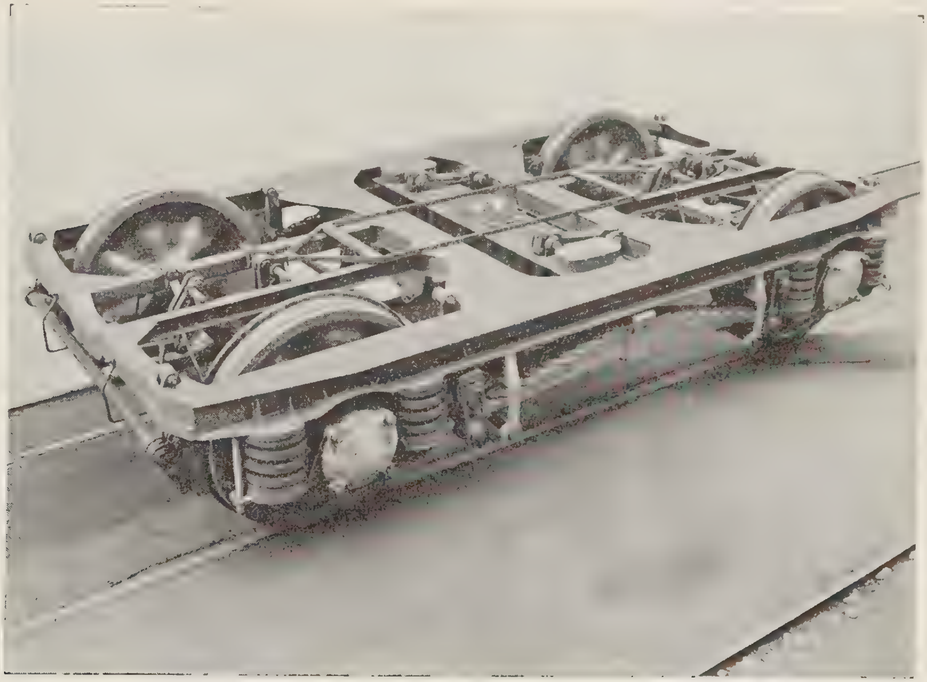


Fig. 30. — 30 SWS type bogie for light steel cars. Primary suspension with 3.5 cm/t flexibility springs.

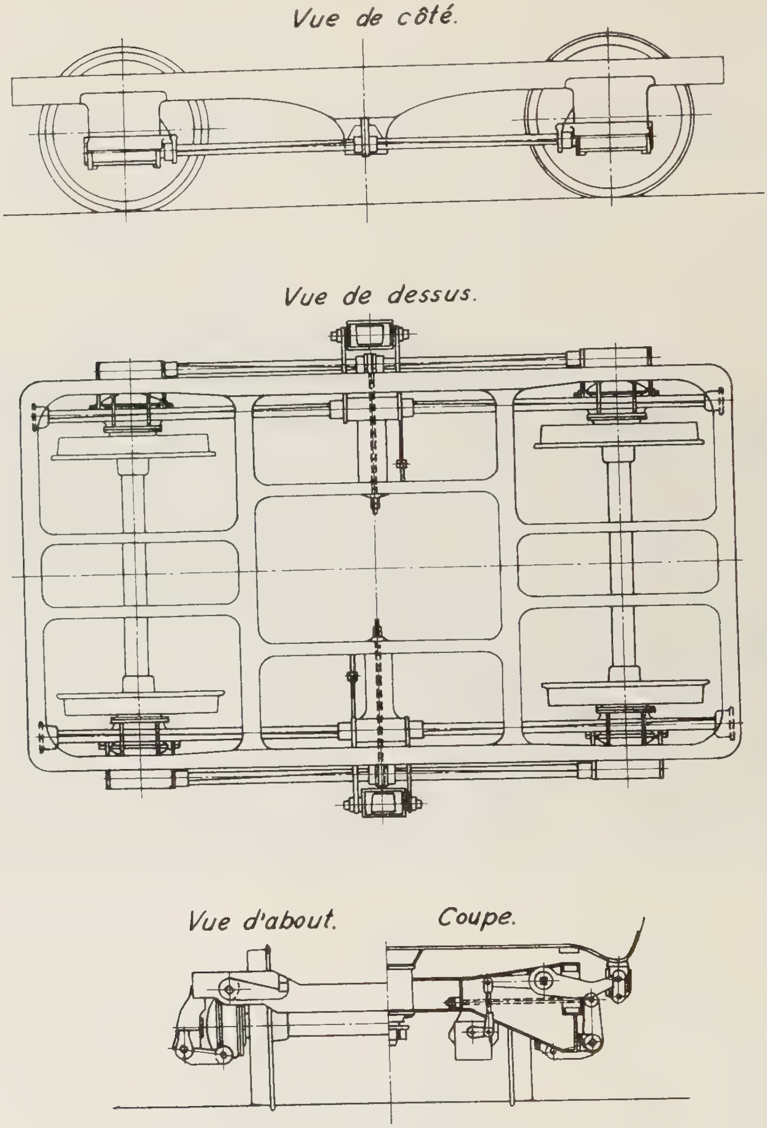


Fig. 31.

Explanation of French Terms. — Vue de côté = Side view — Vue de dessus = Top view
Vue d'about = Front-end view — Coupe = Section.

at speeds up to 110 km/h (66 m.p.h.) and tyre wear has not been very great. They have given the vehicles noticeably smooth riding. To improve running at higher speeds, it has been necessary to fit Broulhiet type hydraulic shock absorbers to each torsion bar of the body suspension.

C. F. R. bogies are similar in principle to the C. F. F. shewn in fig. 28, modified to suit the different gauge.

Bogies of modernised E. B. T. B. coaches are exclusively C. F. F. type for light trains, that is, built by the Schlieren (Zurich) Wagon Works; these bogies have a swing bolster.

Tables 8-11 contain information on flexibility of springs and composition of steels used for springs.

type, of the Est Region, built about 1936, which have intermediate rubber springs, there are the following arrangements :

1) saddle of armoured rubber, 4 cm (1.57 m) thick, *between the pivot beam of the body and the pivot socket,* the loading being :

23 kg/cm² (327 lbs per sq. in.) for heavy

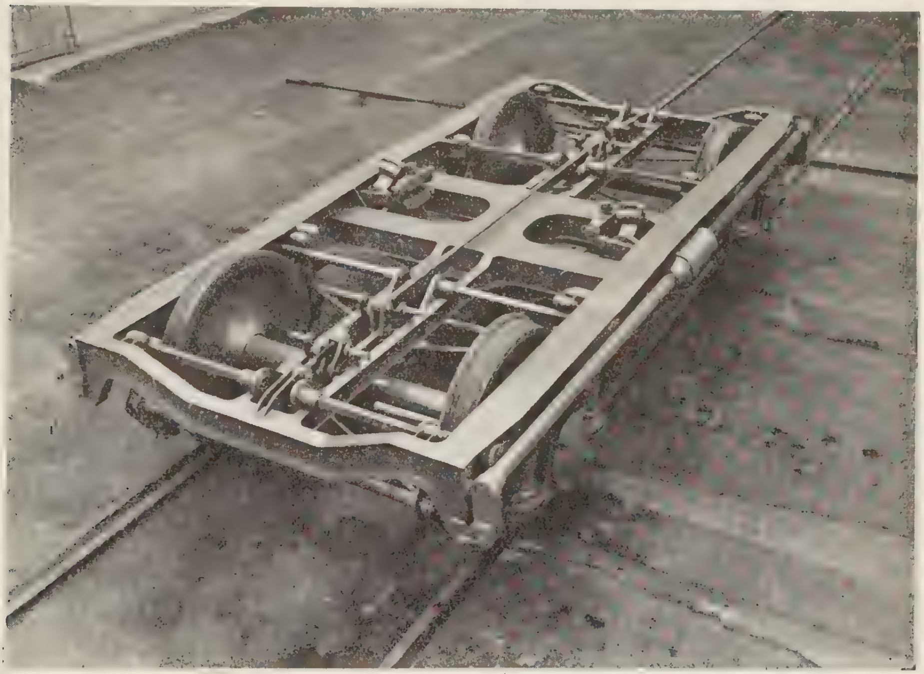


Fig. 32.. — II SIG type bogie.

coaches, with 47 tons tare and 5 tons load;

14 kg/cm² (199 lbs, per sq. in.) for light vehicles (suburban stock) with 32 tons tare and 5 tons load.

2) armoured rubber saddle about 2.5 cm (0.98 in.) thick, *under the 1st stage helical suspension springs* the loading being :

15 kg/cm² (213 lbs. per sq. in.) for heavy vehicles;

9.5 kg/cm² (277 lbs per sq. in.) for light vehicles.

With regard to intermediate rubber springs, the S. N. C. B. state that these have not been used so far, but that international vehicles under construction will have intermediate rubber springs on the swing bolsters, side bearings and driving pivot.

The D. S. B. and N. S. B. use intermediate rubber springs between the body and the bogie.

The S. N. C. F. no longer uses intermediate rubber springs on modern bogies. For example, on the SID bogies, Pennsylvania

Comparative trials with a coach fitted in this way and an identical coach having no intermediate rubbers in the suspension have shewn that the vibrations experienced are identical. The arrangement was therefore discontinued in subsequent constructions.

Under the pivot socket and in suspension springs the N. S. use rubber washers as follows :

	Pivot socket	Springs
Effective surface of washer, cm²	1 120	292
Loading of washer, in kg/cm² (empty)	20	20
Tickness of washer (under load) mm.	13.8	17.1
Shore hardness of rubber	45	45

The C. F. F. use intermediate rubbers in the primary suspension of SWS type bogies.

The various arrangements are shewn in the drawings forming figs. 32-36.

Fig. 32. — standard arrangement with helical spring, 3.5 cm/ton deflection, and rubber washer between the spring and the axlebox.

Fig. 33. — trial arrangement fitted to ten vehicles, the springs being placed between two rings of special rubber.

Fig. 34. — arrangement adopted on a certain number of vehicles now being delivered, comprising a double seating of three concentric rubber washers (Pirelli type) placed above the spring.

Fig. 35. — experimental arrangement use on a B4ü carriage, in which the helical springs are replaced by t/o belled rubber springs (Pirelli).

Fig. 36 — experimental arrangement used on coaches under construction, in which the helical spring (compression 4.6 cm/t) is mounted between two rubber washers.

With regard to vertical oscillation, the arrangements in figs 33, 34 and 36 are practically equal. The arrangement in fig. 35 has not given good results and its use is being discontinued.

The use of wheels with rubber insertions, or tyres mounted on rubber is noted in Chapter A. 1. I.

For damping vertical oscillation, the S. N. C. F. Pennsylvania type bogies have a suspension which is damped by friction between the laminations of the opposed springs used in the second stage suspension.

In the special case of sets running on pneumatics, the suspension is damped by the use of hydraulic shock-absorbers of the telescopic, tourist-carriage, type.

Finally, on Y20, high speed type bogies which are on trial, as mentioned earlier, shock absorbers are used for the second stage suspension and for damping lateral oscillation of the swing bolster (see fig. 25).

In the SWS type, C. F. F. bogie, see figs 28 and 29, vertical oscillation is damped by an SWS type hydraulic shock-absorber combined with the axlebox guides. Damping is obtained by the flow of oil through small-diameter orifices. In general, there are 12 holes of 6 mm diameter.

In SIG bogies, oscillation is partly damped by friction in the bearings of the torsion bars.

Characteristics.

L extended = 235 mm

Dm = 203 mm

n total = 5.5

□ = 28 mm

f per 100 kg = 35 mm

Calculation of spring
Drawing SWS 80799

Axle-box guides and suspension
Drawing SWS 69419

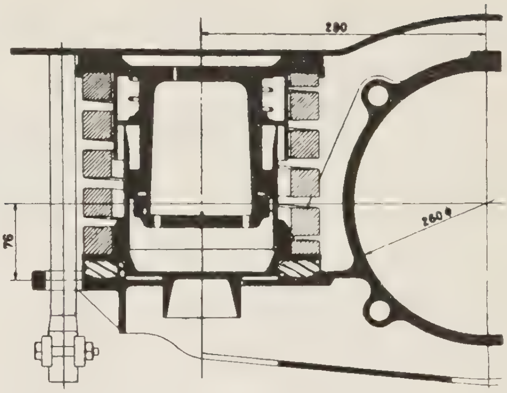


Fig. 33.

Characteristics.

L extended = 235 mm

Dm = 203 mm

n total = 5.5

□ = 28 mm

f per 100 kg = 35 mm

Calculation of spring
Drawing SWS 80799

Axele-box guides and suspension
Drawing SWS 89882

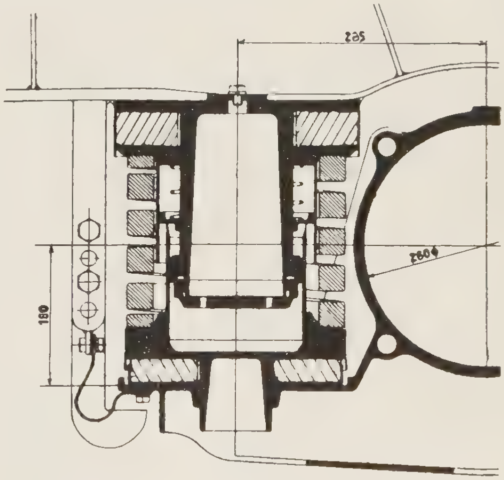


Fig. 34.

Fig. 37 gives the hysteresis diagram of the opposed leaf springs used on Pennsylvania bogies of the S. N. C. F. (flexion 15 mm/t).

In Pennsylvania type bogies of the S. N. C. F., only the second stage suspension, of laminated springs, shows mechanical hysteresis, but the corresponding diagram for this type of spring has never been compiled.

The hydraulic damping of the pneumatic tyred sets is of very recent application, and its coefficient has not been determined.

On S. N. C. B. bogies, the swing bolsters are carried on opposed leaf springs which are suspended from the intermediate cross members of the bogie by inclined links, 245 mm long, with a spacing at the lower pivots of 1 460 mm and at the upper pivots of 1 370 mm.

TABLE VIII. — E. Stab

H = Helical springs. L = Laminated springs P = Opposed leaf springs T = Torsion bars	Norma			
	between axlebox and bogie			
	Type	Suspended weight t	Flexion mm	Flex mm
S. N. C. B. (Belgium)				
International coaches under construction . .	H	14.8 — 16.3 2)		2.9
Other coaches	H	18.4 — 24.4 2)		2.9
D. S. B. (Denmark)				
AV	H	15.1	39.9	2.6
S. N. C. F. (France)				
Main line coaches.	H	16.5 1)	62	3.7
Suburban coaches.	H	14.5 1)	55	3.8
C. F. A. (Algeria)				
Bogie type Y 2 R	H	19.5	58	2.9
N. S. (Holland)	H	19.8		15
C. F. F. (Switzerland)				
S W S bogie (existing)	H	12 2)		4.
S W S bogie (future)				5.
S I G bogie I	T			3
S I G bogie II	T			2

g. — I. Carriages.

n				
between bogie and body				Remarks
Type	Suspended weight t	Flexion mm	Flexion mm/t	
L	13.4 — 14.9 2)		4 1)	1) At the bogie pivot.
L	15.5 — 21.5 2)		4 1)	2) According to the type of carriage.
P	12.73	123.3	9.68	
P	14.75	74	5.02	1) The normal static load is taken as equal to the tare plus 5 ton load.
P	12.75	64	5.02	
L	17	60	3.53	
P	16		14.5	
L	10.3		14.5 1)	1) Before additional springs operate; afterwards the flexion becomes 3.75 mm/t.
			14.5 1)	
T			10.0	2) Tare.
T			8.25	

TABEL IX. — E. Stabili

H = Helical springs L = Laminated springs P = Opposed leaf springs	Normal			
	between axlebox and bogie			
	Type	Suspended weight t	Flexion mm	Flexi mm/
S. N. C. B. (Belgium)				
1939 triple, driving bogie		29		2.9
carrying bogie		22.9		3
1939 double, driving bogie		35.3		2.8
carrying bogie		30.4		2.2
1939 single, driving bogie	1)	29.2		2.5
carrying bogie		19		2.5
1941 single		14.3		7.5
D. S. B. (Denmark)				
MO-IV 3 axle carrying	H + L	31.64	101	3.2
MO-IV 2 axle driving	H + L	22.56	108	4.8
« Flash » trains :				
MB 2 axle carrying	H + L	32.76	121	3.8
MB-EJ 2 axle driving	H + L	30.40	115	3.8
EJ 2 axle carrying	H + L	17.15	96	5.6
S. N. C. F. (France)				
Y 143 bogie (driving)	L + H	16.5	120	7.3
Unnumbered	L	25.6	46	1.79
Y 101	L	21.8	87	4
Y 107	H	18.4	41	2.2
Y 145	L + H	13.7	66	4.8
C. F. G. (Algeria)				
Brill bogie (driving)	H	14 1)	45	3.
Brill bogie (carrying)	H	17 1)	45	2.
N. S. B. (Norway)				
Cmdo 6	H			2
Cmdo 7	H			6
Cmdo 8	H + L			3.
N. S. (Holland)				
2 axle driving	H	21.5		2
2 axle carrying	H	22.6		2
2 axle carrying	H	22.3		2
2 axle carrying	H	17.6		2
3 axle carrying	H	40.2		[illegible]
2 axle driving + 1 axle carrying	H	42.5		[illegible]
2 axle carrying	H	17.8		[illegible]
2 axle driving	H	20.8		[illegible]

ng. — II. Railcars.

n				
between bogie and body				Remarks
Type	Suspended weight t	Flexion mm	Flexion mm/t	
L	16.8		9.5	1) Helical, laminated and helical or laminated springs.
L	19.25		4	
L	22.4		5.2	
L	26.4		3	
L	17.3		4.5	
L	16.5		4.5	
L	14.3		—	
L	16.46	117	7.1	
L	17.08	120	7	
L	14.68	101	6.9	
L	23.2	118	5.1	
L	13.14	143	10.9	
1)				1) Spherical pivot. Side checks with helical springs.
L	15.9	106	6.65	
H	18.6	109		
H	16.4	129	7.89	
.+H	12.3	169		
				1) Tare.
L		15		
L		25		
+H	14 1)		9.5	1) Weight of body empty.
L	7.4 1)		15 2)	2) Springs correspond to those of the swing bolster on other vehicles.
L	23 1)		6	
+H	6.9		11.6	
+H	9.3		9.3	
+H	9.145		9.3	
+H	6.03		11.6	
P	9.02		10.7	
P	9.91		10.7	
+H	6.13		11.6	
+H	6.54		11.6	

TABLE X. — E. Stabili

H = Helical springs L = Laminated springs P = Opposed leaf springs	Normal			
	between axlebox and bogie			
	Type	Suspended weight, t	Flexion mm	Flexio mm/t
S. N. C. B. (Belgium)				
1939 (driving)	H or L	33		3
1939 (carrying)	H or L	22.3		3
1946	H or L	29.3		3
1950	H or L	24.4		3
Belgian Light Railways	H	7.49		11.4
D. S. B. (Denmark)				
MM-III (driving)	H	25	48	1.9
FS-III (carrying)	H	15.6	32.8	2.1
S. N. F. C. (France)	H	27.6	71.5	2.6
R. A. T. P. (France)				
Driving	L	9.2		6.[illegible]
Carrying	L	9.2		6.[illegible]
N. S. B. (Norway)				
Express trains	2)			4.[illegible]
Suburban trains.	3)			3.[illegible]
N. S. (Holland)				
Driving bogie.	H	21.8		10[illegible]
Carrying bogie	H	26.2		10[illegible]

g. — III. Rail motor coaches.

	between bogie and body			Remarks
ype	Suspended weight, t	Flexion mm	Flexion mm/t	
L	21.8		4	
L	19.1		4	
L	25		4	
L	20.7		4	
P 1)	4.69		12.7	1) Certain modern coaches are suspended on helical springs only. These are duplicated by central rubbers, which act as shock absorbers.
P	17.9	151	8.4	
P	13.7	127	9.3	
	20.1	80.5	4	Normal static load taken as the tare (52 tons) increased by 9.2 tons.
L 1)	14.4		3.7	1) With rubber mounted pivot.
H 1)	13.3		5	
2)	27 1)		9.5	1) Weight of body empty. 2) A laminated spring in series with two parallel helicoidal springs on each axlebox and one large laminated spring at each end of the swing bolster.
3)	28 1)		7.3	3) One helical spring over each axlebox and one apposed leaf spring at each end of the swing bolster.
L	15		23	
L	22		23	

TABLE XI. — **Composition of steel etc**

	Steel used	Chemical analysis					Not harden[ed]	
		C %	Si %	Mn %	P %	S %	Tensile kg/mm²	El[on]ga[tion] L=
S. N. C. B. (Belgium)	Martin electric hearth or crucible	0.47-0.55	1.6-2.0	0.5-0.8	≦ 0.05 1)	≦ 0.05 1)		
Belgian Light Railways	Silico-manganese	0.6						
D. S. B. (Denmark)		0.40-0.55	1.5-1.8	0.5-0.75	≦ 0.05	≦ 0.05	≧ 85	
S. N. C. F. (France) Main line	S spring steel		1.8-1.9 1)	0.45-0.50 1)	≦ 0.07			
Omnibus and motor coaches								
Normal carriage loading								
Railcars 3)								
S. G. C. E.	Silico-manganese							

ngs. — E. I. Stability of running.

Hardened		Max. loading		Heat treatment	Remarks
ile m²	Elongation L=10 d %	Laminated kg/mm²	Helical kg/mm²		
		60-65	45	Water hardened, between 20 and 30°, from 880° C. Reduced to about 475° and maintained at this for about 20 minutes.	1) P + S $\leqq$ 0.09.
		48.7	41.5	Water hardened (950°) to 425°.	
40 1)	$\geqq$ 6			With water hardening (50-60°) the temperature of the steel should be 820-850°; after that steel is reheated to 470-520° for about 20 minutes and air cooled.	1) Ultimate tensile $\geqq$ 110 kg/mm²; hardness 350-420 Brinell.
		51 2)	outer 32.5 2) inner 36.5 2)	The treatment comprises hardening at between 850°-900° in oil or water, 20-25° C followed by re-heating, at a core temperature of over 400°.	1) The technical specification allow wide latitude to the manufacturers in composition and requires only a maximum phosphorus content of 0.07 %. They call, however,for mechanical properties covering tensile, bend and impact tests. For example, the steel used by one supplier has the composition shown (chrome 0.4-0.5 %). 2) For normal static load taken at tare plus 5 tons load. 3) The springs are computed so that fatigue, due to static or dynamic overload, causes blocking up, to a maximum of 80 kg/mm² in flexion for laminated springs and 76.5-0.391 d kg/mm² in torsion for helical springs with a rod diameter of *d* mm ($d \geqq$ 60 mm.)
		44 2)	outer 28.5 2) inner 32.5 2)		
		$\leqq$ 60	$\leqq$ 40		
		$\leqq$ 55	$\leqq$ 40		

TABLE XI. — **Composition of steel etc**

	Steel used	Chemical analysis					Not hardene	
		C %	Si %	Mn %	P %	S %	Tensile kg/mm²	El ga L=
R. A. T. P. Normal load Exceptional load	S steel 1)							
C. F. A. (Algeria)	S steel, hardened							
C. F. G. (Tunisia)	S treated							
C. F. M. (Marocco)								
C. F. I. (Indi-Chona)	S steel							
N. S. B. (Norway)	Mild steel, suitable for water hardening	0.50-0.65	1.50-1.80	0.55-0.70	$\leqq$ 0.05	$\leqq$ 0.05	$\geqq$ 85	$\geqq$
N. S. (Holland)								
Carriages : Laminated springs		0.42-0.48	1.50-1.80	0.60-0.70	$\leqq$ 0.04	$\leqq$ 0.04	85-95	
Helical springs		0.45-0.55	1.50-1.80	0.50-0.75	$\leqq$ 0.05	$\leqq$ 0.05	85-95	
Railcars : Laminated springs		0.40-0.55	1.50-1.80	0.50-0.75	$\leqq$ 0.05	$\leqq$ 0.05	85	
Helical springs		0.45-0.55	1.50-1.80	0.50-0.75	$\leqq$ 0.05	$\leqq$ 0.05	85-95	
Laminated springs Motor coaches : Laminated springs Helical springs								
C. F. F. (Switzerland) Laminated springs Torsion bars under static load	Silico-chrome							
C. F. R. (Switzerland)	Special F.C. 300 (Krupp)							
E. B. T. B. (Switzerland)	F.C. 300							

Hardened		Max. loading		Heat treatment	Remarks
sile nm²	Elon-gation L=10 d %	Laminated kg/mm²	Helical kg/mm²		
		60-65 80-88			1) S. N. C. F. technical specification S.
					To S. N. C. F. technical specification.
140 1)	$\geqq 5$	$\leqq 65$	$\leqq 40$ 2)	Water temperature 20-40°. Steel 820-850° C, reheated to 470-520°. With fusion bath treatment the lower temperature limits are valid.	1) After hardening and reheating steel hardness should be 370-450 Brinell; for the top plate a minimum of 350 is allowable. 2) Also valid for volute springs.
				The heat treatment used is left to the discretion of the supplier.	1) Ultimate tensile 125-135 kg/mm². 2) Apparent load — special profile. 3) Ultimate tensile 110 kg/mm².
-160 1)	6-5	130.64 2)			
-160	7-5		59.95		
.0 3)	5	111			
160	7-5		68.70		
		130.70 2)			
		141.9 2)	54-58.5		
160 1)	6-5	113.0 2)			1) Ultimate tensile 125-135 kg/mm². Hardness 380-420 Brinell. 2) Special profile. 3) Torsion bar; pull under static load 37.0-40.6 kg/mm².
160	6		64.5 3)		
		81.3	33.3		
160 1)	6-5				1) Ultimate tensile 125-135 kg/mm². Hardness 380-420 Brinell.
160 1)	6-5				1) Hardness 380-420 Brinell.

Characteristics.

L	=	272 mm
Dm	=	203 mm
n total	=	6
□	=	28 mm
per 1 000 kg	=	48 mm

Calculation of spring

Drawing SWS 94057

Axle-box guides and suspension

Drawing SWS 94297

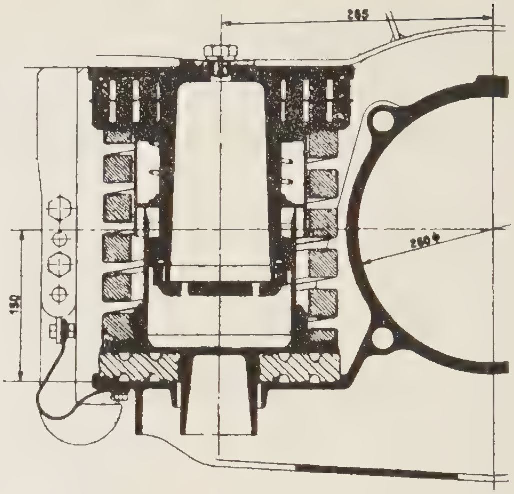


Fig. 35.

Rubber springs

Pirelli drawing SAGA 698

Axle-box guides and suspension

Drawing SWS 95453

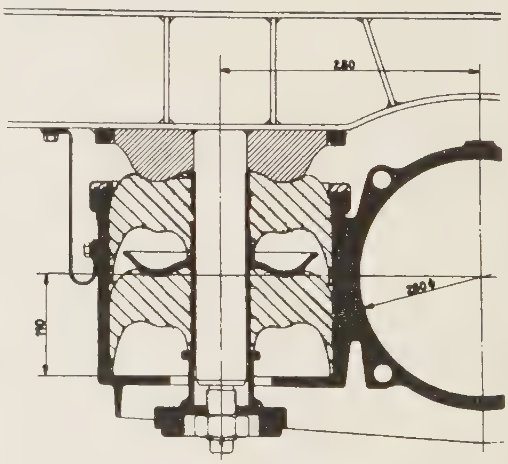


Fig. 36.

The lateral play of the swing bolsters is 2 × 20 mm (2 × 0.787 in.). The side checks comprise the solid heels of the rubbing blocks between the swing bolster and the intermediate cross member of the bogie. These parts are of semi-chilled steel.

There is no initial centring of the bolster. In the maximum lateral displacement of the bolster (20 mm), the recoil is 192 kg/t to the bogie pivot.

In the coaches at present in service, the body is carried by the swing bolster, through the centre socket, forming a spherical bearing. Side bearings give a normal

Characteristics.

L extended = 272 mm

Dm = 203 mm

n total = 6

☐ = 28 mm

f per 1 000 kg = 46 mm

Calculation of spring
Drawing *ZfW* 21031

Axle-box guide and suspension
Drawing *ZfW* 21031

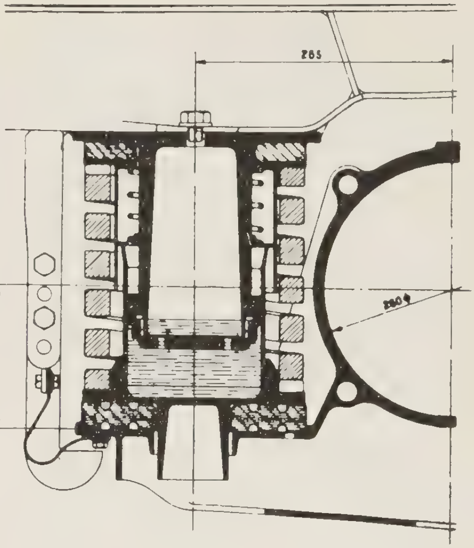


Fig. 37.

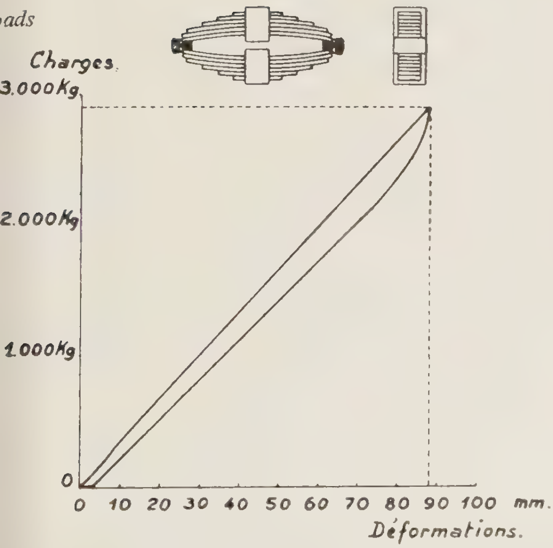


Fig. 38. — *S. N. C. B.*
Hysterisis graph of a Pennsylvania bogie elliptic spring. — Scales : loads 1 mm. — 30 kg; deformation : 1 mm.

play of 0.5 mm (0.019 in.) and limit the rotation along a longitudinal axis of the body in relation to the bogie.

In international coaches under construction, the body rests on the bogie by side rubbing blocks exclusively.

The maximum play in the axlebox guides is 2 × 5 mm (2 × 0.196 in.) and no special measures have been taken to retard the development of play.

S. N. C. V. bogies have swing bolsters with trapezoidal suspension and the length of the hangers is 300 mm. Inclination 1 : 6. There are wood side blocks. The body rests, through shoes, on four sets of two cylindrical rollers each. The pivot itself, with spherical seating, transmits only horizontal forces. Play in the axlebox guides is 2 mm (0.078 in.) and in the swing bolster 2 mm. There are wearing plates of 12 % manganese steel.

On modern D. S. B. bogies, the swing bolsters are carried on opposed leaf springs, hung from the intermediate cross members of the bogie by links 235 mm long. The spacing of the upper and lower

pivots is 1 430 mm. The links are not inclined. The lateral play of the swing bolster is 2 × 20 mm. The side bearings have a normal vertical play of 1 mm and the maximum permissible transverse play in the axlebox guides is 2 × 5 mm.

The Pennsylvania bogies used on modern S. N. C. F. stock have a swing bolster resting (through opposed leaf springs of the second stage suspension) on the saddle connected to the bogie frame by inclined links.

The features of the connection by inclined links are shewn in the sketch forming fig. 39.

The side checks of the swing bolster are small plates connected to the ends of the bolster, which at the limit of travel bear on blocks fixed to the intermediate cross members of the bogie frame.

In the Y 20, high-speed bogie, at present on trial (see fig. 25), the swing bolster rests on the frame through helical springs with a transverse flexibility allowing both lateral displacement of the swing bolster and the necessary recoil loading. The horizontal links from the swing bolster to the frame do not offer any resistance of a rigid nature to lateral displacement of the bolster, owing to their articulated silent-bloc mounting, the rubber of which supports the distortion caused by the non-parallelism of the axes of the metal parts

The recoil effort which results from the use of inclined links described above (fig. 39) is equal, at a first estimate, the coach being empty, to 0.9 tons per cm displacement of the swing bolster (figure calculated from the radius of curvature from the position described by the centre of gravity of the body of the vehicle).

The maximum permissible transverse displacement of the swing bolster is equal to :

± 25 mm (0.984 in.) for main line vehicles;

± 15 mm (0.59 in.) for vehicles, used on stopping trains.

On the Y20 high speed bogie now on trial (fig. 26) the maximum transverse displacement of the swing bolster is ± 25 mm and the centring forces equal to 1 100 kg²cm 15 645 lbs per sq. in.) displacement from the position of equilibrium.

The carriage bodies rest on the swing bolster through a central socket and two side rubbing blocks. For this purpose, the side rubbing blocks are mounted on the swing bolster by helical springs, designed to give a weight distribution of the vehicle body (empty) as follows :

50 % of the weight of the body on the two sockets;

50 % of the weight of the body on the side rubbing blocks.

On the experimental Y 20 (fig. 25) all the weight is carried on the side bearings.

The maximum permissible play is as follows :

1) *in the axlebox guides :*

originally :

± 0.5 mm (0.0196 in.) parallel to the track centre line;

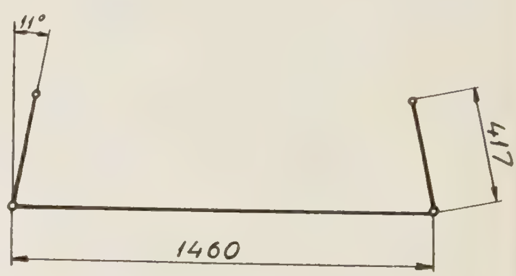


Fig. 39.

± 2 mm (0.078 in.) perpendicular to the track centre line.

after wear :

± 6mm and ± 7 mm (0.236 and 0.275 in.).

2) *in the swing bolster guides :*

A play of ± 1 mm (0.039 in.), parallel to

the track centre line is provided originally and at each periodical overhaul.

To retard increases of this amount of play, the tendency is to fit wearing plates of manganese steel on the rubbing parts.

On the prototype Y 20 bogies, however, no play is provided in the bogie motion parts. The equalisers are integral with the axleboxes, and connected to the frame by horizontal silent-bloc links transmitting motive force or retention of axles without play or rubbing surfaces.

Similarly the connection between the bolster and the frame is by another group of silent-bloc links, obviating all play and wear by rubbing of these parts.

The slope of the links of N. S. B. bogies is about 8° and the lateral displacement of the swing bolster 40-50 mm (1.57-1.96 ins.). Play in the axlebox guides is about 2 mm. The boxes and guides are fitted with case-hardened liners.

N. S. bogies have inclined links 447 mm long, lower pivots spaced 1 530 mm upper pivots 1 354 mm. The body rests normally on the bogie through the pivot socket. Rubbing blocks are not normally in contact, the play between them being 1 mm. The pivot socket of the carriages allows a 5° inclination of the bolster in relation to the body, this being a special provision of the R. I. C. for bogie vehicles used for ferry-boat services.

The maximum play allowed in the axlebox guides is 4 mm (0.157 in.) and 5 mm (0.196 in.) longitudinally in the swing bolsters.

To retard the creation ofplay, manganese steel liners are used at wearing points.

The swing bolsters of SWS type, C. F. F. bogies (see figs. 28 and 29) have a lateral tolerance of ± 45 mm (1.77 in.) The suspension links have a length of 265 mm and an inclination of 7°.

The swing bolster of II SIG type bogie (see fig. 31 above) has a lateral play of ± 30 mm (1.181 in.). The suspension links have a length of 300 mm and an inclination of 10°.

There are no side checks.

The centring force of the swing bolsters depends on the amount of displacement. With a displacement of 15 mm (0.59 in.), there is, for example, in the SWS type bogie a centring force of 555 kg (1 223.5 lbs).

The arrangements adopted for body bearings of these bogies is shewn in the general bogie drawings. The SWS type bogie arrangement is preferred, i.e. the centre pin socket carrying the full weight of the body and side rubbing blocks working only on curves. This arrangement gives the bogie great freedom of movement, which, on this system where curves are particularly numerous, appears essential. The method adopted on the SIG, type 11, bogie gives practically the same results as the SWS method.

The axlebox guides are of special construction, without play, and have given excellent results in service. The construction is shown in figs. 32, 33, 34, and 36.

Horizontal oscillation of the bogie, and consequently of the body, are damped by Broulhiet type hydraulic shock-absorbers.

In connection with the reduction of vibration of the body, which reveals itself especially in the central portion of lightly constructed coaches, the S. N. C. F. gives the following information :

lightly-constructed vehicles are prone to body vibration, which manifests itself more or less noticeably in the central part of the structure. The reduced rigidity arising from extensive weight reduction lowers the characteristic frequency of the body construction to a figure approximating to the revolutions per second of the axles rotating at the normal operating speeds (110-130 km/h [68-80 m.p.h.]). In this condition resonance can and does arise (despite precautions taken in regard to the suspension) whenever the weels have a slight geometrical or mechanical defect of centring (an excentricity of 0.5 mm is sufficient to produce this phenomenon).

An extreme case of this is the pneumatic tyred S. N. C. F. coaches, in which the bodies alone weigh about 4 tons only, for a total length (excluding buffers) of 23.180 m (76.04 ft.) and a distance between bogie centres of 16 m (52.49 ft.). In these vehicles, despite recent improvements in the suspension, vibration sometimes arises which can be readily noticed by an observer looking for it, although it is not troublesome to passengers.

The remedy, as regards the body, must be sought in a rational distribution of the material used in construction, giving the body the maximum of rigidity for a given weight. The sections which appear to play a preponderant role in this respect are the frame members (headstocks and solebars), window mountings and transverse partitions when these are provided.

The S. N. C. F. is at present making a systematic study of this question, based on static and dynamic tests at a fixed point (vibration tests) and on running lines with suitable equipment.

In 1948 the S. N. C. F. carried out a trial consisting of the fitting of tyres turned at 1 : 40 on a saloon coach. The degree of stability achieved with this modification was not appreciably better and the arrangement was discontinued.

Since the first light-construction coaches were put into service, the C. F. F. has attempted to reduce vibration at the centre of the body. Complete elimination has not been achieved however. The problem is of great complexity and will require much trial and research before a solution is found which is satisfactory in all respects.

When necessary, the intensity of these vibrations have been reduced somewhat by using intermediate rubbers in the primary suspension (see fig. 36) and increasing the flexibility of the suspension.

All bogie coaches of heavy or light construction have tyres with a conicity of 1 : 40. The results obtained with tyres of this section can be considered satisfactory.

E. 1. — II. Railcars.

The S. N. C. B. railcars covered in this report are as follows :

1) triplet cars, hydraulic transmission, put into service 1939;

2) double railcar, mechanical transmission, put into service 1939;

3) single railcar, mechanical transmission, put into service 1939;

4) single light railcar, mechanical transmission, put into service 1941.

Type	Bogie arrangement	Suspension		Remarks.
		M	C	
Triple, 1939	MCCCCM	Gorlitz	Pennsylvania	M : driving bogie
Double, 1939	M C M	Gorlitz	Pennsylvania	C : carrying bogie
Single, 1939	M C	Gorlitz	Gorlitz	
Single, 1941	M M	Springs on boxes.		

The driving bogies of the 1939 double and single railcars have no swing bolsters, the body is borne by cradles on longitudinal laminated springs.

The bogies of the 1941 light car have no swing bolsters. The body rests on a centre socket fixed to the bogie frame.

The driving bogie of the 1939 double railcar is shewn in fig. 40.

The S. N. C. V. use Pennsylvania type bogies.

The modern D. S. B. railcars have a bogie without swing bolster, see fig 42. The primary spring mounting between the frame and the axlebox is laminated springs with a helical spring at each end. Secondary spring mounting between the bogie and body is effected by two laminated spring sets fitted longitudinally along the bogie, to the coach sides. The weight of the body is transmitted through rollers to the springs.

Displacement of the body in relation to the bogie is checked by rubber springs fitted round a central pivot with a plain bearing to damp rotation of a minor nature of the bogie relative to the body. On the more modern railcars the centre pin is fixed to the body so that the rubber-mounted bearing is located in the bogie. It has been noted that oscillation due to movement of the bogie during running is transmitted in a reduced degree to the body if the centre pin is fitted to the bogie.

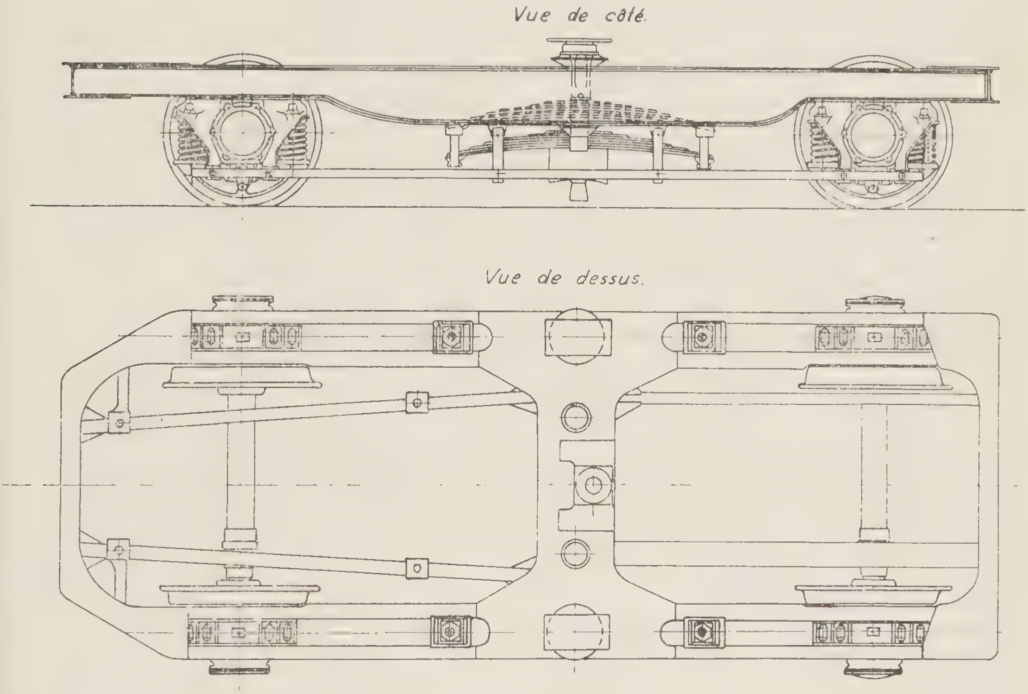


Fig. 40.

Explanation of French terms : Vue de côté = Side view. — Vue de dessus = Top view.

Several bogies of the « flash » trains, also constructed on the system described above, have a central pivot at each end and two sets of lateral springs; the bogies used are common bogies for articulating two vehicles.

About 340 railcars in S. N. C. F. stock at present have bogies without swing bol-

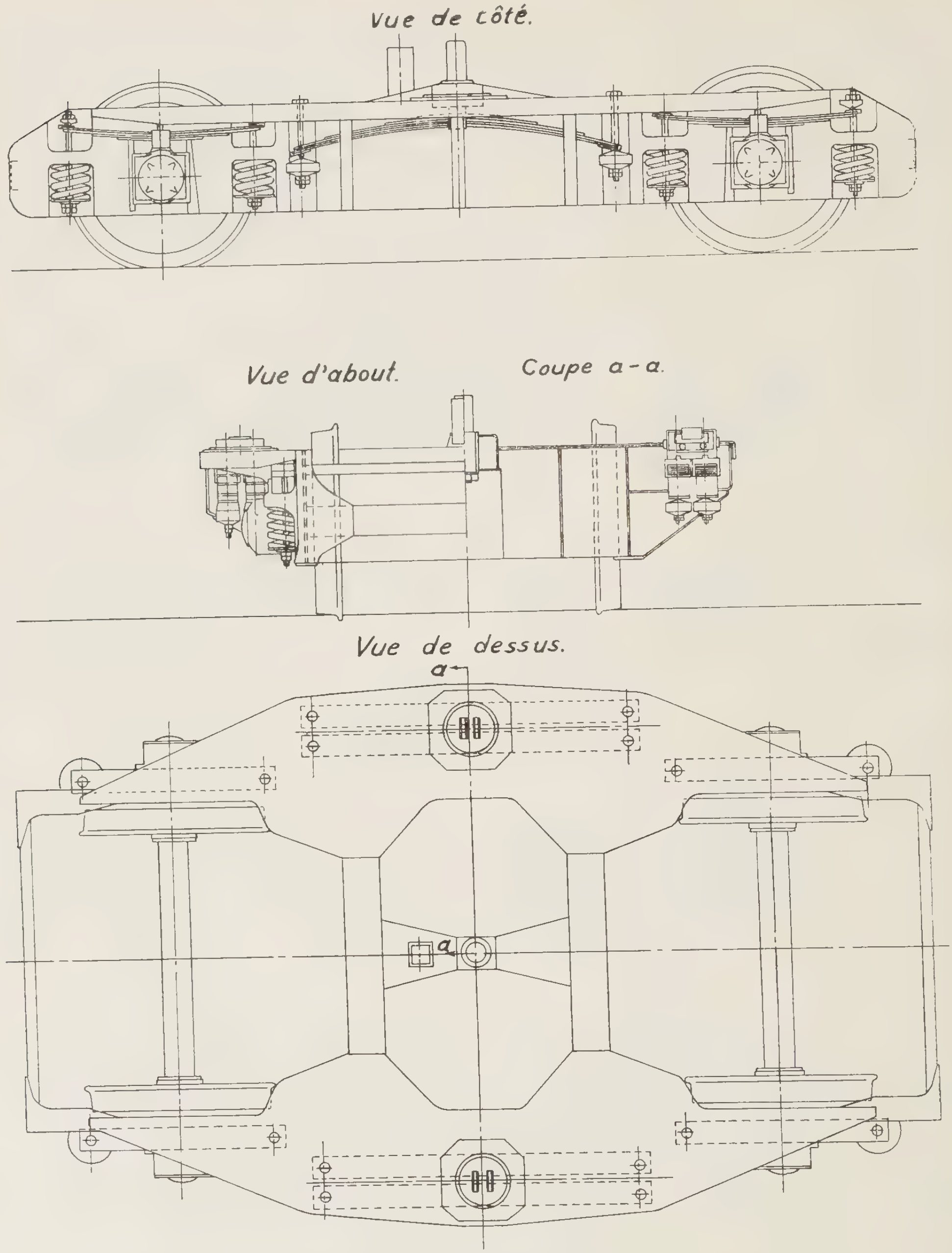


Fig. 41.

Explanation of French terms : Vue de côté = Side view. — Vue de dessus = Top view. — Vue d'about = Front end-view. — Coupe = Section.

ster or similar arrangement. On these vehicles, therefore, the body has no movement relative to the bogie. The most numerous of this category are the Renault railcars (260 units). The renault type bogie has no secondary suspension; part of the weight of the body rests on the bogie through the centre pin (about 66 %) and the remainder (34 %) by resilient side bearings.

The S. N. C. F. also uses a certain number of railcars of the type known as « Standard » (about 80 units) equipped with bogies having no swing bolsters, but having a secondary suspension of two laminated springs, arranged parallel to the solebars of the bogies and carrying the entire body weight (the bogie pivot transmitting only horizontal forces).

On good track the Renault type bogies behave very well when new. At high speeds they tended to set up a hunting motion, which could be accentuated on poor track and when appreciable play developed in the axleboxes; this tendency has been met by increasing the load on the side bearings up to 34 %, as mentioned above, and by fitting the side bearing slides with friction liners (Ferodo).

The « Standard » bogies provide greater comfort on poor track, but are also prone to hunting, although to a lesser degree, when the axleboxes begin to shew play.

In brief, experience has shewn that, up to speeds of about 100 km/h. (62 m.p.h.) and on track with an average standard of maintenance, bogies without swing bolsters provide reasonable comfort providing steps are taken to keep to a minimum the play in axleboxes and slides.

S. G. C. E. railcars have a special Dion-Bouton bogie, of very low construction, allowing a very much reduced height of floor.

The bogies comprises two radial axles connected by a frame carrying the body on two longitudinal springs.

The body of the bogie is made up of plate strongly stayed to the bogie longitudinals. This electrically welded plate is carried on roller bearing boxes by coil springs, which act as shock absorbers. Moreover, the presence of these springs allows the axles to depart from the same rigid plane and to absorb vertical irregularities of the track, without imposing abnormal stresses on the four wheels.

The springs which carry the body are solid with a false axle which forms a cross-bearer. A pivot transmits braking forces, and driving forces from the bogie frame through the false axle.

The weight of the body rests, through the springs and the false axle, on the outer longitudinals (solebars) of the frame, by means of rubbing surfaces of tempered steel.

The pivot of the cross-bearer is not fixed rigidly in relation to the bogie frame, but is fixed to a moveable piece which slides in a guide, forming part of the frame. The moveable piece is held in its normal position by two springs.

C. F. G. railcars have Brill type bogies of cast steel, with swing bolster.

C. F. I. railcars use special Renault bogies.

The bogies of N. S. B. types 6, 7 and 8, railcars are shewn in fig. 41.

The N. S. two-axled, bogies are of the C. F. F. type, modified; i.e. similar to the construction shewn in figs 28 and 29.

Three axles bogies have spring equalisers.

Bogies without swing bolsters are not used.

Tables IX and XI give information on the flexibility of springs and on the composition of steel etc. used for the springs.

C. F. G. railcars have rubber insertions in the seatings between the pivot and the swing bolster, and under the side bearings, but these are intended more to prevent the propagation of noise than to improve running stability.

The C. F. I. use rubber under the pivot socket and ends of suspension springs.

On N. S. B. railcars there are intermediate rubbers in the centre and side bearings and in the suspension springs.

Under the pivot socket, the N. S. use rubber washers, as follows :

Effective surface of the washer in cm^2 : 1 120.
Thickness of the washer, in mm (under load) : 20.
Loading of washer, in kg/cm^2 (carriage empty) : 13.4.
Shore hardness of the rubber : 45.

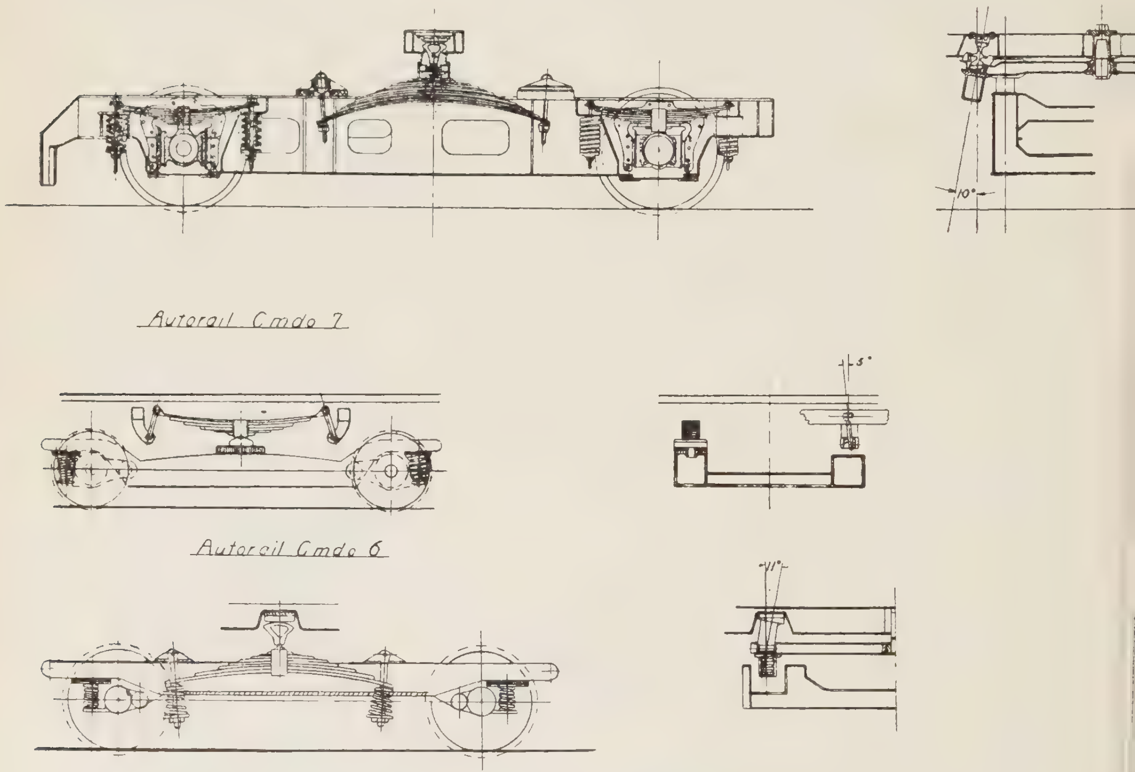


Fig. 42. — Diagram of springs in rail-car bogies (with Diesel engines).
Explanation of French terms : Vue de côté = Side view. — Vue d'about = Front-end view. — Coupe *a-a* = Section *a-a* — Vue de dessus = Top view.

The use of wheels with rubber mountings, or wheels with rubber-mounted tyres is dealt with in Chapter A. 1. — II.

In general, vertical oscillations in S. N. C. F. railcars are damped by friction of the spring laminations. In view of the irregularity of this damping, however, and the often excessive degree of friction which interferes greatly with the correct functioning of the laminated springs, the present tendency is to give preference to helical springs.

Primary suspension is generally fairly hard, and the helical springs have not so far given satisfactory results without the addition of shock absorbers, at least for speeds below 120-130 km/h. (74 and 80 m.p.h.).

On recent railcars, the secondary suspension of which comprises helical springs exclusively, hydraulic absorbers are used. This

arrangement applies particularly to the 300 HP railcars bogies.

Certain railcars (Bugatti) include friction dampers in the secondary suspension. For efficient service, these dampers require constant adjustment.

Vertical oscillation in S. G. C. E. railcars is damped by coil springs.

The S. N. C. B. has given the following information relating to railcars bogies :

1939 triple railcar :

Driving bogie : the swing bolster rests on longitudinal laminated springs, which are themselves hung from the frame of the bogie by links which are normally vertical, 190 mm (7.48 in.) long. The lateral play of the bolster is 2 × 25 mm (2 × 0.98 in.). the side checks are of semi-chilled steel fixed to the shoulders of the swing bolster and to the bogie solebars.

Initial centring force is nil. Centring at the maximum bolster displacement is 246 kg/ton to the body pivot.

The body rests on the swing bolster through a flat socket which forms at the same time the motion pin. The rotation of the body about its longitudinal centre line is checked by side rubbing blocks which have a normal play of 2.5 mm (0.097 in.).

Carrying bogie : the swing bolster rests on opposed leaf springs which are carried by the intermediate cross-members of the bogie by sloping links, 245 mm (9.64 in.) long, the spacing of the lower pivots being 1 460 mm (4.78 ft.) and that of the upper pivots being 1 370 mm (4.49 ft.).

Lateral play of the swing bolster is 2 × 20 mm (2 × 0.78 in.). The side checks are the solid heels of the rubbing blocks between the swing bolster and the intermediate cross members of the bogie. These parts are of semi-chilled steel.

Initial centring is nil. At the maximum displacement of the bolster it is 192 kg/ton to the bogie pivot.

The body bears on the swing bolster through a central socket which forms a spherical bearing. The side bearings give a normal play of 0.5 mm (0.019 in.), limiting the rotation of the body about its horizontal centre line in relation to the bogie.

1939 double railcar.

The driving bogies have no swing bolster.

The body rests on crutches with slipper blocks on laminated bearing springs arranged longitudinally.

For the carrying bogies, the arrangements are identical with those described above for the carrying bogies of the triple railcars.

Initial centring is nil. At the maximum displacement of the swing bolster it is 192 kg/ton to the bogie pivot.

1939 single railcar.

The driving bogies have no swing bolsters; the arrangements are identical with those described above for the driving bogie of the double railcar.

Carrying bogie : the swing bolster bears on longitudinal laminated springs through sloping links, 100 mm (3.93 in.). The bolster has no lateral play.

The side checks comprise bearing plates of semi-chilled steel, fixed to the swing bolsters and the solebars.

There is no transverse displacement of the swing bolster of these carrying bogies.

The body rests on the swing bolster through a central socket, forming a spherical bearing. Side roller bearings give a normal play of 1 mm (0.039 in.), limiting the rotation of the body on its longitudinal centre line in relation to the bogie.

1941 single railcar.

The bogies of these railcars have no swing bolsters.

The body rests on the bogie through a flat central socket. Side roller bearings give a normal play of 2 mm limiting the rota-

tion of the body on the longitudinal centre line in relation to the bogie.

The maximum permissible transverse play in the axlebox guides is 2 × 25 mm and no special steps have been taken to retard the development of play. Transverse play in the swing bolster is rarely affected by wear.

On S. N. C. V. railcars, the same arrangements have been adopted as those described for carriages.

Swing bolsters on S. N. C. F. Decauville railcars are connected to the bogie frame by four 250 mm (9.84 in.) hangers, inclined at 15° from the vertical. Centring is by gravity and rubber checks limit the travel to ± 20 mm.

These arrangements have given very good results. In addition, the cars retain, as regards the suspension, all their original qualities when lifted after completing a mileage of 200 000 km (124 270 miles).

On the 300 HP S. N. C. F. railcars and trailers, the links which replace the hangers are vertical; their length is 304 mm (11.96 in.) on the railcars and 367 mm (14.44 in.) on the trailers. Centring is by gravity and the travel is limited to ± 15 mm (0.59 in.) by uncushioned contacts on the 300 HP railcars, and by rubber blocks on the trailers.

The side bearings of the Renault railcars are generally of an assembly of Belleville rings, on a Ferodo lined shoe which rubs on a steel slide solid with the bogie.

On the second series Decauville railcars, the side bearings comprise four combined helical springs bearing on slipper blocks.

As regard the 300 and 600 HP S. N. C. F. railcars which are under construction the body rests on the bogies by a secondary suspension in which the bogie frame links can slope to allow the rotation of the bogie and also lateral displacement of the body.

On bogie trailers, each of the side bearings comprises a laminated spring, combined with two helical springs, the body resting on the laminated springs through a slipper block.

Whilst, in the case of the 600 HP railcars and the trailers, the driving couple between the body and the bogie is effected by two links provided with flexible washers linking the motion pin of the body to the bogie frame, this connection is effected in the case of the 300 HP railcars, in which the centre portion of the bogie is taken up by the lowering, by cables, fixed rigidly to the body and articulated at the bogie headstocks.

The original play provided in the axlebox guides is 2 mm parallel to the track and 0.5 mm perpendiculary.

On standard vehicles, the usual axleboxes with slides have been replaced by boxes connected to the bogie frame either by laminated suspension springs or by a special device.

The 300-600 HP railcars, S. N. C. F. type, have roller bearing boxes between the wheels with silent-bloc guides mounted in the driving plates; these plates are fixed at the centre, one to the top of the box and another to the bottom of the box, and attached to the bogie frame through rubber washers in the eye-ends.

On C. F. G. railcars, the ends of the swing bolster bear on two large lateral springs. It is held in positioin by two recoil links, fixed to the end of the bolster and the bogie solebar.

The two body pivots are located in the sockets fixed to the swing bolster.

At the ends of the swing bolsters, which are fitted with rubbing blocks, there are under the body, side shoes which bear on the rubbing blocks on curves; this arrangement is designed to check body movement.

The maximum permissible play between the roller bearing boxes and the guides is 11 mm.

On N. S. B. railcars, the length and slope of the links is as follows :

Type 6	350 mm	11°
Type 7	295 mm	5°
Type 8	400 mm	10°

The transverse displacement of the swing bolster is limited to 40-50 mm (1.57-1.96 in.) by metal side checks.

On types 6 and 8 there are side bearings (the pivot not carrying), and on type 7, side hangars (no pivot).

Play in the axlebox guides is about 2 mm, the axleboxes and guides have steel liners, faced with Mintex.

N. S. railcars with three-axle bogies are fitted with vertical links, 355 mm (13.97 in.) long and two-axle bogies with links with adjustable length (370 mm [14.56 in.] with an empty vehicle and 410 mm [16.14 in.] loaded). The construction of the side and longitudinal checks is similar to that on carriages. Lateral play with three-axle bogies is 35 mm (1.37 in.) (not in contact) and a maximum of 40 mm (1.57 in.); longitudinal play is 1.5 mm (0.058 in.).

Two-axle bogies have a device for damping lateral movement. This comprises two low-power laminated springs in the bogie frame fitted with asbestos plates at the ends. The swing bolster has four steel plates on which rub the asbestos plates. Lateral play is 27 mm (1.06 in.) (not in contact) and 32 mm (1.25 in.) maximum. Longitudinal play is 1.5 mm.

The arrangements for the body bearings and the play allowed for the axlebox guides are similar to those described for carriages.

On S. N. C. F. railcars, lateral oscillations are damped by hydraulic shock absorbers.

General vibration of the body is reduced by the use of a secondary suspension, which is sufficiently flexible, and does not comprise laminated springs.

Vibration in the central portion of the body is generally caused by a shortage or bad arrangement of floor members, which should be suitably reinforced.

Vertical acceleration records, obtained during running stability trials, have shewn that railcars with a lightly constructed body often show this vibration; the oscillation frequency is 15 per second at speeds of 120-130 km/h and their amplitude often reaches a value of about 0.5 g. It seems well established that this resonance is set up by slight faults in the turning of the wheels.

In C. F. G. railcars, horizontal oscillation is damped by the fact that the lateral springs are spaced as far as possible from the pivot and also that the brake arrangement has been provided on the top trunnions of the spring links.

D. S. B. « flash » trains and other express railcars have tyres turned with a conicity of 1 : 40.

All S. N. C. F. railcars have tyres with a 1 : 40 coning, except TAR type, which have cylindrical tyres. Experience has shown that reduced conicity of tyres also reduces hunting movement at high speeds.

E. 1. — III. Rail motor coaches.

On rail motor coaches the S. N. C. B. uses Pennsylvania type bogies. On the 1939 type motor coaches the motor is suspended by laminated springs on the axleboxes and the motor suspension is independent from that of the body.

On S. N. C. V. motor coaches Pennsylvania type bogies are in use.

The new D. S. B. motor coaches are fitted with the bogies shewn in fig. 42; other motor coaches have Pennsylvania type bogies.

Motor coaches in service on the S. N. C. F. have driving bogies of various types, with one or two stages of suspension and with or without swing bolsters.

The present tendency, on motor coaches now in design, is to use Pennsylvania type bogies, improved to avoid development of play and wear in service.

R. A. T. P. motor coach bogies are shewn in fig. 43 (driving bogie) and 44 (carrying bogie). Most of the existing vehicles do not have swing bolsters in the real sense of the word, that is, with a lateral displacement allowed by suspension links; the low

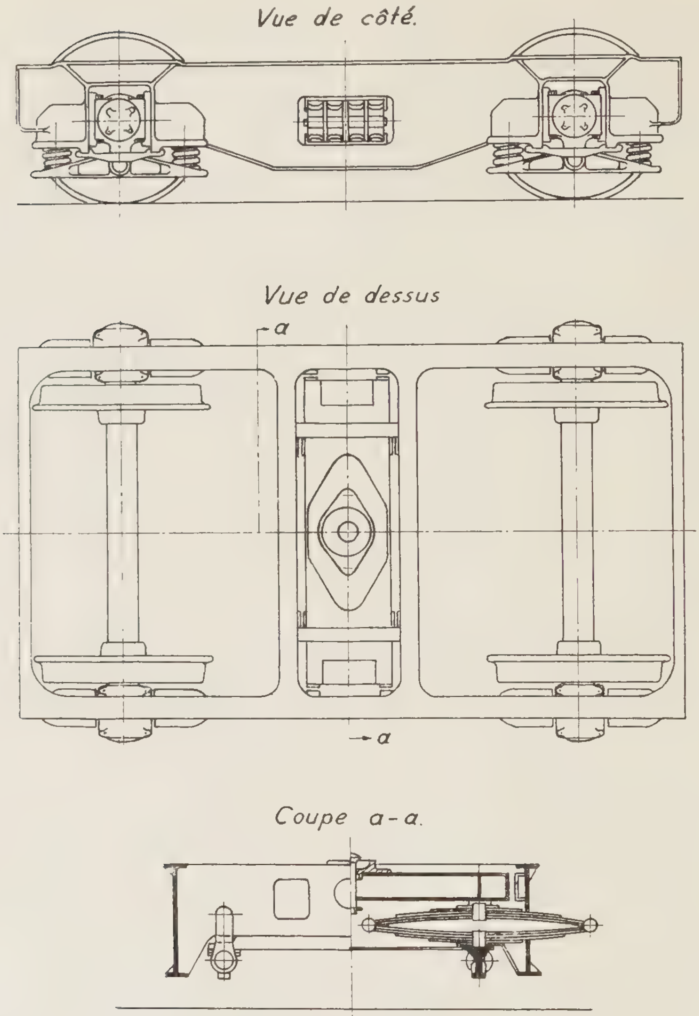


Fig. 43.

Explanation of French terms : Vue de côté = Side view. — Vue de dessus = Top view. — Coupe *a-a* = Section *a-a*

speeds, and restrictions imposed by curves of very small radius make this necessary.

Construction of N. S. B. motor coach bogies is shewn in fig. 45.

The N. S. uses bogies with spring equalisers on motor coaches.

Bogies with swing bolsters are not used.

C. F. R. bogies are dealt with in Chapter E. 1. — I.

Tables X and XI contain information received in respect of elastic flexion of springs and composition etc., of steel used in their manufacture.

Intermediate rubbers are provided on the motion pivot and side bearings of driv-

Section through longitudinal girder showing primary suspension and lateral bearing points. Transversal section.

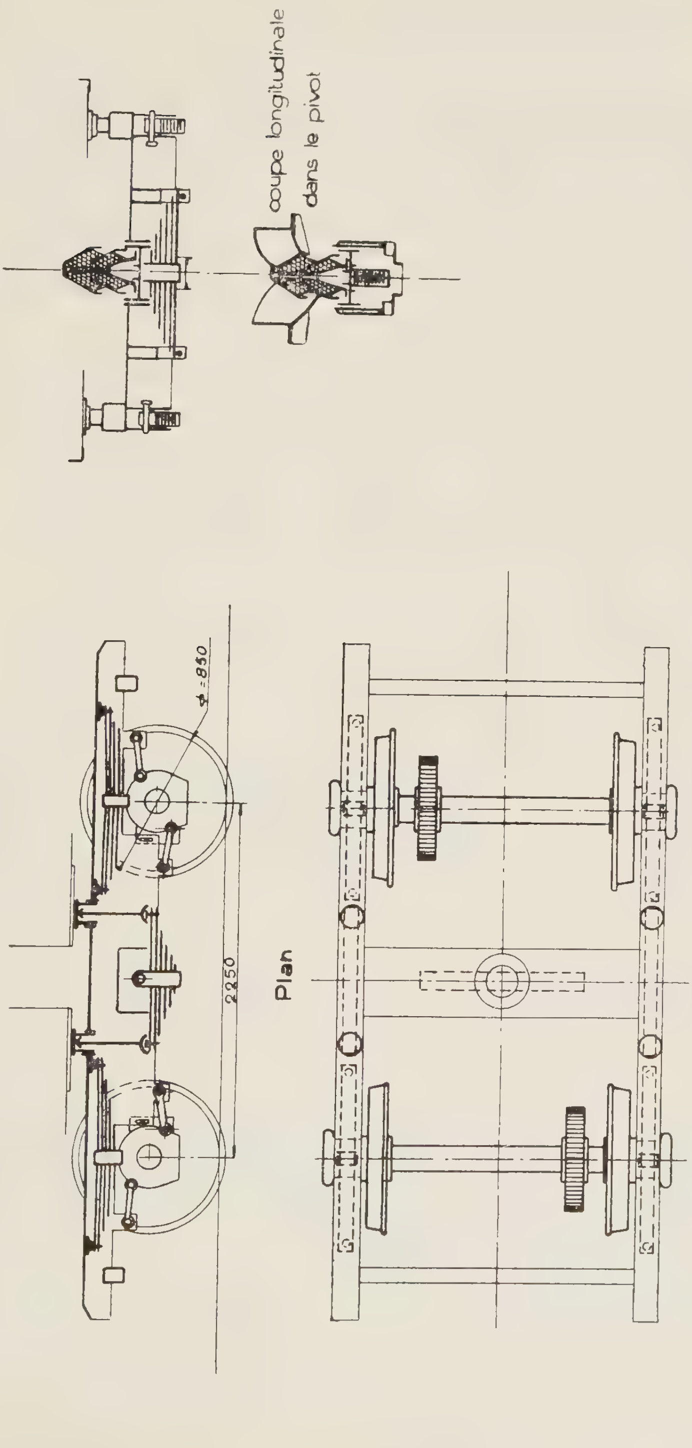
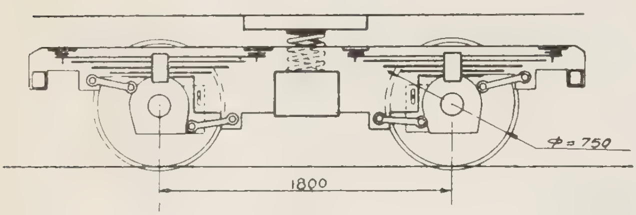


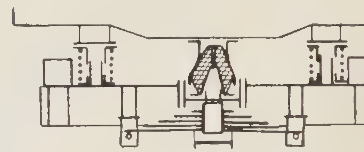
Fig. 44. — *Régie Autonome des Transports Parisiens.* — Articulated rolling-stocks. — Motor bogie.

Explanation of French terms : Plan = Plan view. — Coupe longitudinale dans le pivot = Longitudinal section through pivot.

Section through longitudinal girder showing primary suspension and lateral bearing points.



Transversal section.



Plan

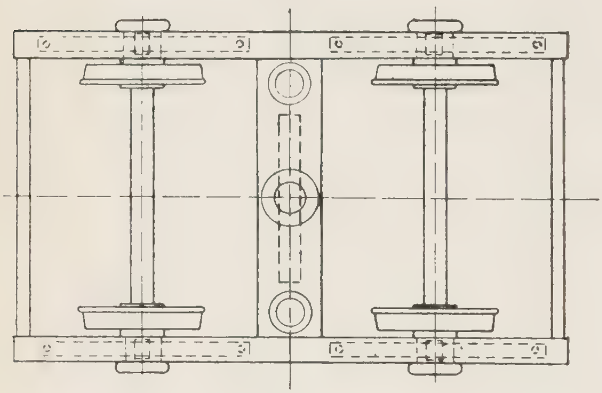


Fig. 45. — *Régie Autonome des Transports Parisiens.* — Articulated rolling-stock. — Carrying bogie.
Explanation of French terms : Plan = Plan view.

ing bogies of the 1939, 1946 and 1950 motor coaches of the S. N. C. B. The loading (with the vehicle normally loaded and at rest) is 24 kg/cm² (341 lbs per sq. in.) maximum.

On certain S. N. C. V. motor coaches rubber blocks are fitted in parallel with steel springs (dampers) and on the same motor coaches hydraulic shock absorbers, Houdaille type, are provided for damping vertical oscillation.

The D. S. B. and N. S. B. use intermediate rubbers in the centre and side bearings.

The intermediate rubbers mentioned in Chapter A. 2. — III. in connection with S. N. C. F. motor coaches are subjected to a loading of 17 kg/cm² (241 lbs per sq. in.) compression.

Under the socket and in the suspension springs, the N. S. use rubber washers in motor coaches, as follows :

	Socket	Springs
Surface of washer in cm²	1 120	408
Thickness of washer, in mm. (under load)	20	20
Loading of washer in kgr/cm² (coach empty)	13.4	16.2
Shore hardness of rubber	45	50

The use of wheels with rubber insertions or rubber mounted tyres is dealt with in Chapter A. 1. — III. It can be added that the S. N. C. V. uses wheel centres with rubber buffers on modern motor coaches and that trials are to be undertaken by the R. A. T. P.

As regards S. N. C. F. motor coach bogies, vertical oscillations are damped in the manner described above on Pennsylvania type bogies and on C. F. R. bogies helical springs with oil dampers are used.

On S. N. C. B. motor coaches the swing bolsters rest on opposed leaf springs which are suspended from the intermediate cross members of the bogie by inclined links, 245 mm long, the spacing of the lower pivots being 1 460 mm and the upper pivots 1 370 mm.

Lateral play of the swing bolster is 2 × 20 mm. The side checks are situated as follows :

Driving bogies, 1939, 1946 and 1950 types :

Rubber check fixed to the bogie solebar and located opposite the vertical faces of the swing bolster.

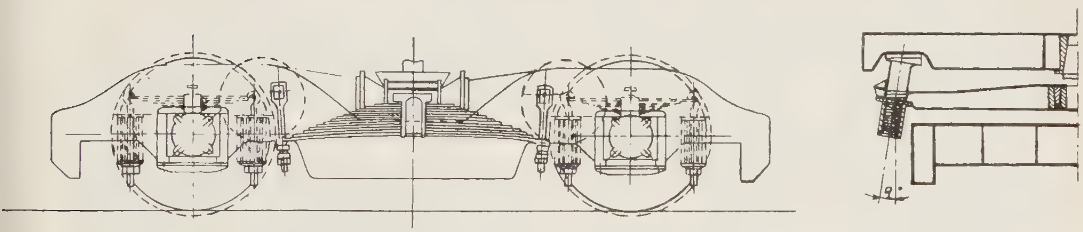
The body rests on the swing bolster by side bearings; the centre pin is for haulage only.

Carrying bogie, 1939.

Solid heels of the rubbing blocks between the swing bolster and the intermediate cross members of the bogie.

The body rests on the swing bolster through a centre socket forming a spherical bearing. Side roller bearings give a normal play of 0.5 mm and limit the rotation of

Bogie for electric motor coach of fast train.



Bogie for electric motor coach local train.

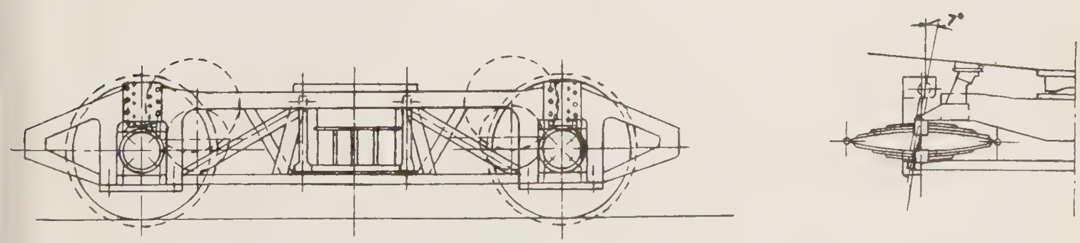


Fig. 46. — Diagram of the springs in the rings (bagues) of electric-motor coaches.

the body on its longitudinal centre line in relation to the bogie.

Initial centring of the swing bolster is nil.

At the maximum lateral displacement of the bolster (20 mm) the centring force is 192 kg/ton to the bogie pivot.

The maximum permissible transverse play in the axlebox guides is 2 × 5 mm.

No special steps have been taken to retard the formation of play.

Transverse play in the swing bolster is rarely affected by wear.

On S. N. C. V. motor coaches the arrangement is identical to that of carriages.

Future suburban motor coaches of the S. N. C. F. at present in design will have in principle a suspension arrangement with swing bolster similar to that on carriages. The length and slope of the links, however, will be adjustable on the first units built to obtain experience regarding the optimum dimensions to be adopted.

The centring force on future suburban motor coaches will be decided by the result of these tests.

The maximum transverse displacement to be provided is ± 25 mm and there will be rubber checks.

The tendency on S. N. C. F. motor coaches is to carry the full weight on the side bearings.

The maximum permissible play is as follows :

1) *in the axlebox guides* :

— *new* :

± 0.5 mm parallel to the track centre line;

± 1 mm perpendicular to the track centre line;

after wear :

the amounts should not exceed ± 1 mm and 4 mm respectively.

2) *in the swing bolster guides* :

Same as for carriages. At the same time, to retard the formation of play, the tendency is to use friction surfaces of wear resisting material, e.g. manganese steel.

On R. A. T. P. motor coaches the load is distributed between the pivot and the side bearings.

The N. S. use on bogies of motor coaches, hangers as follows :

	Length, mm.	Slope.
Express trains. . . .	350	9°
Suburban trains. . .	430	7°

The maximum lateral displacement of the swing bolster is 50 mm on express trains and 40 mm on suburban trains.

For express trains there are sector rollers and the pivot is not loaded, whilst the side bearings also have sector rollers.

Play in the axlebox guides is about 2 mm. The boxes and guides are fitted with liners, case-hardened or faced with Mintex.

Bogies of N. S. motor coaches have vertical links, 350 mm long.

There is no centring arrangement, but a damper similar to that fitted on railcars for lateral movement is used.

The construction and composition of the side checks are the same as for carriages and railcars, the play being about 40 mm (not in contact) with a maximum of 45 mm. The longitudinal checks have been abandoned, on account of the construction of the guide links.

The links are fitted with rubber washers, which allow longitudinal and lateral movement of the swing bolster.

The arrangement of bearings for the body and the play allowed in the axlebox guides are the same as those described for carriages.

On several modern motor coaches of the S. N. C. V. hydraulic shock absorbers are fitted between the swing bolster and the bogie frame.

On existing motor coach bodies which are not of very light construction, the S. N. C. F. has not experienced any vibration due to light construction of the body.

On R. A. T. P. motor coaches the bogies are coupled to the frame by links, articulated with silent-blocs (Alsthom) for controlling the recoil of the axles from lateral displacement.

In regard to express trains, the N. S. B. have in hand very successful trials with « Luvax » shock absorbers for horizontal oscillation on motor coaches with a driving compartment; it is, however, too early to state the results. It is intended to undertake the same trials on motor coaches of express trains.

On certain modern motor coaches with speeds of up to 85 km/h (53 m.p.h.) the S. N. C. V. has improved stability and overcome hunting by turning the wheels cylindrically.

E. 2. Two or three-axle vehicles.

The S. N. C. B. has constructed, experimentally, several types of two-axled railcars. A series of 56 two-axled railcars for secondary lines has also been built. The replies which follow refer to this series of 56 railcars.

Suspension is by laminated springs on the axleboxes and the flexibility of each spring on the box is 20 mm/ton.

There is no special arrangement for damping oscillation or for reducing horizontal oscillation.

Play of the box in the axleguard is 2 × 0.5 mm longitudinally and 2 × 0.5 mm transversely.

The S. N. C. V. has no three-axle railcars and no modern carriages or motor coaches with two or three axles.

The S. N. C. F. has some two-axle railcars for service on minor lines, with a maximum speed restricted to about 65 km/h (40 m.p.h.). They have roller bearing boxes with slides and guards, and the laminated bearing springs are mounted in the normal way.

Following satisfactory trials with a prototype, the S. N. C. F. ordered some light trailers with two axles, tare 6 tons, maximum speed 90 km/h (55 m.p.h.). They have roller bearing inside axleboxes on normal axles, connected to the body by laminated springs, the ends of each engaging rubber blocks in the manner adopted on American road vehicles. In the absence of any longitudinal and transverse play, the behaviour of the prototype light trailer, at 90 and even 100 km/h (62 m.p.h.) is satisfactory.

The E. B. T. B. has adopted double suspension and laminated springs for its two-axle coaches.

E. 3. Measurement of stability.

Apart from some measurement of carriage movements with a « Hallade » recorder, which have only a comparative value, the question of stability of carriages and motor coaches on the S. N. C. B. has been purely subjective.

The S. N. C. V. has taken transverse stability measurements on certain vehicles, to overcome hunting, with an accelerometer and strip recorder. The diagrams obtained have been valuable in deciding the suspension of these vehicles.

The S. N. C. F. has undertaken stability measurements on carriages during running. The method is based on the appreciation of actual comfort, defined by the measurement of vertical and transverse acceleration, the vehicle being placed in the most unfavourable position in the train (at the rear of the train with play in the buffers).

The apparatus used included a *quartz* accelerometer with electronic amplifier and visual indication or recording by cathode oscillograph.

On the vehicles described above, the maximum recorded accelerations have been within the following limits :

a) vertical acceleration over the rear bogie pivot : 0.12 to 0.19 g.

b) transverse acceleration over the rear bogie pivot : 0.07 to 0.13 g.

c) transverse acceleration over the leading bogie pivot : 0.10 to 0.18 g.

Measurements of stability in running have been carried out also on current types of railcars. The results obtained have been practically the same, whatever the type of car tested.

At a speed of 120 km/h (74 m.p.h.) the transverse accelerations recorded in the body over the bogie pivot are generally within the limits of 0.10 to 0.15 g and the maximum rarely exceeds 0.20 g.

The C. F. F. measures the running stability of carriages with an accelerograph which records on a paper strip, running at a constant speed, the oscillations of the vehicle in the following three directions :

a) lateral;

b) vertical;

c) longitudinal.

Measurements have been taken on various light vehicles on the same section of line at speeds of 130-135 km/h (80-83 m. p.h.). It can be stated that the amplitude of the oscillations depends on the degree of damping of the apparatus, which is influenced by the temperature. This factor must be taken into account when examining the diagrams. A leaflet, giving full information on the use, construction and operation of the recording apparatus used, is issued by Trüb-Täuber, Zurich.

In examining these diagrams, it has been noticed that the vehicles tested have an adequate running stability, having regard to the high speeds, which was practically the same in all cases. The SIG, type II bogie, gives remarkably free and smooth running, particularly as regards vertical oscillation. The lateral stability is not quite so good, especially on track in a poor state of maintenance, as with the SWS bogie.

Numerous records of lateral and vertical accelerations have been taken with a « Huguenard » accelerograph, which was loaned to the C. F. F. by the S. N. C. F. technical department. This apparatus made it possible to determine the influence of the intermediate rubbers and springs of various degrees of flexibility in the primary suspension on vibration of high frequency (10-12 per second) in the body centre.

The trials and resulting records showed that the solution illustrated in fig. 36 gave the best results. Unfortunately it has not been possible to reproduce in this report the specimen diagrams which were submitted in response to the questionnaire.

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SUMMARY.

The use of pneumatically-mounted tyres or resilient wheels to reduce noises caused by wheels passing over rails is not extensive. Apart from trials only comparatively lightly-loaded axles have been fitted. Such wheels demand special measures in relation to track circuits. In certain cases the use of resilient wheels has caused undesirable vertical vibrations in the vehicle when running at high speeds and opinions obtained on the results do not differ greatly.

Attempts are being made to reduce chatter or vibration of brake rigging etc. by arrangements in which the moving parts and the play allowed are reduced as much as possible and by rollers and wood or rubber lined brackets.

To deal with noise arising from plates forming body panels use is made of distance pieces and/or panels located at very limited distances with a dressing of asbestos, flock, cork etc. The dressings are sprayed or glued.

Endeavours are being made to eliminate noise from internal combustion engines in railcars by using suitable silencers and mounting the motors on bearings of rubber or other materials. As regards noise from gears of railcars and motor coaches, attempts are being made to combat this by

the use of gear wheels with ground teeth and a careful lubrication of the gearing.

Moreover the suspension of the traction motors and lighting dynamos includes rubber mountings to reduce the propagation into the vehicle of noises from these components.

With regard to the use of insertions of rubber, felt etc., between the body and the bogie, opinions differ.

The propagation of noise inside the vehicle is reduced by the use of double or triple partitions with inner surfaces dressed with flock, etc.

Covering of floors with cork. Expanko etc,. is also intended to provide sound insulation.

In motor vehicles the engine compartment is often located so as to separate the actual passenger compartment by luggage compartments, entrance vestibules or other non-passenger accommodation. In addition, partitions between engine compartments and the neighbouring ones are often sound and fire-proofed.

An important factor in reducing the propagation of noise inside vehicles is to avoid piercing the floor for the installation of piping etc., or at least to ensure that such perforations are carefully covered or packed. Several Administrations remark that the opening of doors and windows has a marked tendency to cancel the effect of measures taken to reduce noise.

Information on the sources of electrical energy, accumulator batteries and the types of lamp used are summarised in Tables 1 — III. In the case of accumulators, automatic recharging by axle-driven or motor coupled dynamos is preferred. The standard of lighting is generally higher in 1st and 2nd classes than in 3rd class. 1st and 2nd class compartments are often provided with reading lights. Night lights and arrangements for reducing normal lighting are frequently provided in vehicles not running in international services. Side corridor coaches are often provided with switches which cut off normal lighting and at the same time switch on the night lights. The use of fluorescent tubes for lighting is increasing. To shield the eyes of passengers from glare, pearl or opal lamps are used and in some cases covers, which at the same time prevent the removal of lamps by the public. Removal is sometimes prevented by using a grill and the marking of lamps with the name of the owning Administration, or by using special sleeves not available to the public.

For emergency lighting candle holders are often provided, but in certain cases an accumulator battery is also provided for electric lighting.

The standard of lighting to be provided is in accordance with the appropriate regulations of the U.I.C. for international services.

Steam heating of carriages is effected at a pressure in the main steam pipe of 44-6 kg/cm² (56-85 lbs per sq. in.) according to the outside temperature and the lenght of the train, but the pressure varies somewhat between Administrations.

The following low-pressure systems are most often used : Westinghouse, Pintsch and Vapor Car Heating. In addition, several Administrations use warm air equipment, heated by steam, frequently with automatic control.

In side corridor coaches, radiators are usually arranged below the side lights and under the seats as also are the warm air injector ducts in the case of this type of heating.

In certain cases steam heating is also provided in railcars, to allow normal steam heated coaches to be used as trailers, but steam heating is not provided anywhere in rail motor coaches.

Electric heating of carriages is generally at voltages of 1 000, 1 500 and 3 000 V. according the use of the coaches. Heating is by radiators or by warm air.

In railcars electric heating is used only occasionally and as supplementary. Rail motor coaches use electric heating exclusively.

Apart from electric and steam heating, there are carriages and railcars fitted with

hot water heating, which allows them to be used in either steam or motorised trains as each vehicle can be heated independently. In view of the risk of freezing in winter, there is a tendency for this type of heating to be discontinued.

Furthermore, the methods of heating railcars differ, for example, by the use of the motor cooling water or by a fuel oil burner with thermostatic on/off control.

Heating by motor exhaust gas is also used.

Regulation of heating is done by train staff or passengers. With centre-corridor vehicles control is frequently exercised by the train staff. In some cases there are thermostats which stop or start the heating at specified temperature limits.

The most common method of ventilation is by extractors in the roof, operated by the passengers. Forced air heating includes electrically-operated ventilation.

Window lights which can be adjusted by passengers also provide a means of ventilation.

Thermic insulation is achieved principally by the use of the same materials mentioned in part A for sound proofing.

Several Administrations already use padded seats in 3rd class, but there seems to be a tendency to replace the present seats in this class by padded seats, particularly in vehicles working in international or long-distance services.

Facing of walls is often laminated board or plates. However, trials are in hand with various plastic and substitute materials.

Floors are generally covered with linoleum; in 1st class, carpets are sometimes provided. Flooring of rubber or magnesium cement is also used.

For interiors, sliding doors are extensively used. Hinged doors are, however, often provided. Outer doors of folding or leaf type are often used.

Tables IV-VI summarise the information received on vehicle seats, net-racks, accessories etc. provided for the passengers. Information on toilet compartments is contained in Table VII.

Compartments reserved for women with young children are provided by some Administrations.

Bogies with swing bolsters are the most common type, but bogies without swing bolsters are also frequently used or are being tried by various Administrations. As regards the use of rubber mountings for the pivot socket or other body support, opinions differ, as noted in Chapter A, although such fittings are often used with spring suspension.

With regard to the flexibility of springs and the type of steel used, the information provided is summarised in Tables VIII-XI.

Vertical oscillations are damped by friction or by hydraulic absorbers, the latter being used also for horizontal oscillations.

Tyres with 1 : 40 coning, or turned cylindrically are used by Administrations to improve running stability, but on a very small scale.

Modern vehicles with two or three axles are used on a limited scale. Such vehicles have been built to some extent for experimental purposes.

Recording apparatus for measuring running stability has been used by various Administrations. This has provided a useful guide for comparison of different arrangements tried on parts connected with the running stability of vehicles.

[656 .255]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

15th. SESSION (ROME, 1950).

QUESTION XV.

Signalling on single track lines.

REPORT

(Great Britain and North Ireland, Dominions, Protectorates and Colonies, America (North and South), China, Burma, Egypt, India, Pakistan, Malay States, Iraq and Iran.)

by H. W. Jackson, M. Sc. Eng.,

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1. — Replies to Questionnaire.

The information embodied in this report was obtained from the following Railway Administrations :

The Egyptian State Railways, Telegraphs and Telephones,

The Sudan Railways,

The Bombay, Baroda and Central India Railway,

The H.E.H. The Nizam's State Railway,

The Pennsylvania Railroad Company,

The Victorian Railways,

The British Railways,

The South African Railways,

to whom thanks are due for the full and detailed information supplied in reply to the questionnaire submitted.

Shortage of staff and prevailing unsettled conditions rendered it impossible for the following Administrations to compile the requested information :

The Iraqi State Railways,

The Burma Railways,

The Nigerian Railways.

2. — Replies. — General.

On perusing the various replies, it was apparent at once that the classes and details of the signalling systems on the different railways were of considerable diversity and some systems bore little resemblance to others.

This dissimilarity would appear to be due largely to the influence of local conditions, and possibly to entirely differing lines of thought in the approach to the subject. Since the questionnaire did not cover this aspect, the writer may be forgiven for not being in a position to advance adequate and correct reasons.

In Table « A », a few relevant facts are given regarding the various railway systems under consideration.

3. — Control between stations.

3.1. — *Token working.*

3.1.1. — *General.*

With the exception of the Pennsylvania Railroad Company, all the railways use, in certain instances, tokens as the proceeding

	Egyptian State Railways	Sudan Railways	B. B. and Railwa
Length (miles) All lines	2 432	2 299	4 064
Length (miles) Single lines	1 926	2 026	3 802
Length (miles) max. Single line	340	?	579
Distance (miles) between passing loops . . .	2 1/4 — 7 1/2	1 1/4 — 48	6 avera
Lengths (feet) of passing loops (max.) . . .	2 166	1 800	2 000
Gauge of track	4′ 8 1/2″ 2′ 5 1/2″	3′ 6″	5′ 6″ 3′ 3 3/ 2′ 6″
Weights of rail lb./yard	42 1/4 — 94.6	50 — 75	41 1/4 –
Number of trains per diem (both directions) .	24	12 — 20	
Speed of trains (m. p. h. max.)	25 — 44	31 — 44	B. G. 35 M. G. 2
Weight of trains (tons, max.)	1 200	1 360	B. G. M. G. Passen
Length of trains (feet, max.).	2 100	1 528	2 24
Method of traction	?	Steam	Stea
Type of signalling.	Mechanical Staff Instruments	Mechanical Token Instruments	Mecha Electr

authority for a train to move from one block station to another. Where electric token instruments are in use, only one train may occupy a section except in the case of the Victorian Railways and the South African Railways and on certain sections of the Sudan Railways.

3.1.2. — *Breakdown or accident.*

Provision is, however, made in all instances, in the case of a breakdown of- or accident to the train in section, for a relief engine or train to enter the section under suitable safeguards for the purpose of rendering assistance to the train which has failed.

Generally, the safeguards consist of :

a) The token must be taken to the nearest station by a member of the train crew — usually the fireman — and be surrendered.

On the Sudan Railways, the driver of the disabled train retains the token but

. E. H. am's State ailways	Pennsylvania Railroad	Victorian Railways	British Railways	South African Railways
1 400	14 453	6 076	51 875	13 331
1 380	6 166	B. G. — 4 277 N. G. — 144	7 175	12 879
?	366	?	5 — 70	840
— 13 3/4	3 — 12	7.7 average	2 — 7	1/2 — 15
1 800	20 000	?	1 200	2 870
′ 6″ ′ 3 3/8″	4′ 8 1/2″	5′ 3″ 2′ 6″	4′ 8 1/2″	3′ 6″ 2′ 0″
1/4 — 90	130 — 150	50 — 110	95	19 1/2 — 96
10	18 — 40	0.14 — 60	12 — 54	1 — 53
0 — 60	75	15 — 70	35 — 75	25 — 60
1 300	1 796 pass. 150 Cars-goods	?	670	1 650
1 800	?	?	1 050	1 830
Steam	Steam. Electric. Diesel. Gas. Electric.	Steam. Electric. Diesel. Petrol.	Steam Diesel cars	Steam Electric
echanical Miniature Instruments	Mechanical Manual block Sound. Light	Mechanical 3 Aspect Colourlight Token Instruments	Mechanical Token Instruments	Mechanical Token Instruments

the fireman must take a Train Failure Advice, issued by the guard, and deliver it to the nearest station master.

b) The disabled train must not be moved until relief arrives.

c) The relief engine or train is allowed to enter the occupied section only when the driver holds a special order which is issued after consultation between the operators at the stations at either end of the section affected.

3.1.3. — *Setting back.*

Except in the case of ballast trains or in circumstances of emergency involving accident, movements may not be made in the direction opposed to that already provided for, and then only if absolute working is in force.

3.1.4. — *Permissive working.*

1. *Sudan Railways.*

Permissive working is restricted to the

running of motor trolleys on certain sections. A motor trolley may precede or follow a train or another motor trolley. A motor trolley may not precede an express or fast mixed train.

When running permissively, the driver of a motor trolley is issued with one half of the Permissive Ticket (a paper form) whilst the other half is handed with the token for the section to the driver of the train.

2. *Victorian Railways.*

Movements on certain lines are controlled by the Train Staff and Ticket system. A train is permitted to set back in the direction from which it has come in an emergency and provided that the driver of the train is in possession of the Staff.

For the information of those who are unfamiliar with this system, it should be explained that the driver of the last train of a series is handed the staff for the section and all such tickets (usually metal tokens) as have not been issued to preceding trains.

3. *South African Railways.*

Staff instruments are being replaced rapidly by tablet instruments. In the latter system, all tokens, whether for absolute or permissive working, are, for any one section, alike. Confusion is avoided by using pouches of differing shapes and the position is clarified still further by attaching to the tablet a warning advice giving details of :

a) the nature of the token delivered to the driver;

b) the number of the preceding train and the time at which that train left the station, whether it has work to perform in the section, or whether it is clear of the section;

c) the number of the train following;

d) the number and character of the train or trains to be crossed or passed at an interloop.

3.1.5. — *Inter working.*

It would appear that, except on the South African Railways, all places where there are crossing loops are signalled and operated as token stations or are controlled remotely as on the Victorian Railways or under the C. T. C. method of control as in use on the Pennsylvania Railroad. On the South African Railways, however, there are many instances of lengthy sections between token stations where economical operation is obtainable by the introduction of what are termed « Interloops ».

Interloops consist of a main line with a loop sufficiently long to accommodate the longest train operating on the section. The signalling of interloops is dealt with elsewhere in this article. Subsidiary instruments, containing special crossing permits, are provided as adjuncts to the normal absolute and permissive tablet instruments and may be so arranged that a crossing between two or more trains is practicable. Each train involved in the crossing carries a crossing token or permit but the last train of each of the opposing series carries the crossing token and the balance of the permits which are exchanged for those carried by the opposing trains.

Where one train has to cross two other opposing trains, this system is undoubtedly economical but where more complicated crossings are arranged, this aspect ceases to be attractive unless the sections are of inordinate length. The policy is to limit the number of trains involved in a crossing.

A passenger train may cross more than one train but an express passenger train may only cross one.

3.2. — *Telegraph order working.*

3.2.1. — Under certain circumstances, the telegraph order of working must be adopted, as for instance in cases where token stations are switched out or where token instruments are out of order, but there are many instances where telegraph order working is in force as the normal method of train control between stations. Because of the ever present possibility of failure of the human element and the large percentage of time spent in exchange of messages, the policy generally is to replace the telegraph order system, both in South Africa and elsewhere.

3.2.2. — On the Sudan Railways, when token instruments are out of order, trains are worked by the « Line Clear » Ticket System. Messages are exchanged over the telephone. « Line Clear » Tickets for «UP» trains are distinguished by a GREEN band down the centre and those for « DOWN » trains by a RED band.

3.3. — *Time table and train orders.*

In the U. S. A., the time table assumes an importance in connection with the running of trains which does not hold in other countries, where it is regarded only as containing the official schedules of recognised regular trains. On American Railways, the time table, unless qualified by a Train Order or Orders or in territory where block signals control trains, governs the movement of trains. In this connection cognizance must be taken of the superiority of trains.

To quote from the book of rules of the Pennsylvania Railroad :

Rule S—71. — A train is superior to another train by right, class or direction.

Right is conferred by train order, class and direction by time-table.

Right is superior to class or direction.

Direction is superior as between trains of the same class.

Rule S—72. — Trains in the direction specified by the time-table are superior to trains of the same class in the opposite direction.

Rule 73. — Extra trains are inferior to regular trains.

3.3.1. — *Train order.*

For movements not provided for by the time-table, train orders are issued. These orders therefore amplify, amend or cancel, as the case may be, the provisions made in time-tables.

Whilst there is a similarity between Telegraph Orders and Train Orders, the former are *always* the authority to move a train between two points whilst the latter constitute such authority only in special cases.

4. — Signalling at stations and passing loops

4.1. — *General.*

The information received as to details of the signalling was, in some instances meagre and allowance for this should be made. Except in certain instances therefore, the principles adopted will be dealt with. Broadly speaking mechanical signalling systems in use on the railways concerned may be subdivided into :

(*a*) key locking systems;

(*b*) interlocking systems.

Under category T(*b*), the Egyptian State Railways use several classes of signalling depending on the importance of the line and the type of station concerned.

The South African Railways does likewise but has many stations which in the absence of semaphore signals, must be regarded as being unsignalled although certain safeguards are provided.

4.2 — *Key-locking systems.*

These are used on the H. E. H. The Nizam's State Railway, the Bombay, Baroda and Central Indian Railway and the Egyptian State Railways.

4.2.1. — *H. E. H. The Nizam's State Railway.*

Figure 1 shows a typical station.

A small lever frame for the operation of the Home Signals 3, 5, 10 and 12 is provided in the approximate centre of the station. Attached to this lever frame are keys X and S for control of the siding points 18 and the Scotch Block (SB).

At the facing points 15 and 16 are single lever frames for the operation of the respective Outer Signals 2 and 13. By means of disengagers on the Home Signals, the Outer Signals may be operated. Thus if the lever controlling signal 2 is used, the signal will answer provided either 3 or 5 has been operated.

Each of the facing points 15 and 16 is equipped with four locks and detectors for

the respective Home Signals. Taking the case of points 16, these are equipped with locks J, K, L and M.

When no train movements are being made, keys B, C, K, L, X and S are in possession of the Station Master. If it be desired to admit an Up train to the Main Line, points 16 must be locked by Key K. This releases key J which when inserted into and turned in the lock on signal No. 3, permits the operation of Signal No. 3 from the lever frame. The pointsman at 16 points may then operate the single lever for Outer Signal No. 2. Similarly, if it were necessary to admit an Up train to the Loop, Key L would be used to lock points 16 for the loop and this would allow Key M to be used for the operation of Signal No. 5. The Outer Signal No. 2 would be operated by the pointsman as before.

and a key released by this latter piece of apparatus which unlocks the signal concerned.

Signals cannot be operated until :

a) The points are set correctly at both ends of the yard for the same road;

b) Both Ground Frames have been locked;

c) Both Hepper's Slides Nos. 29 and 32 have been pulled;

d) A pair of slides relating to the train movement have been pulled;

e) The corresponding slide for the signal has been pulled;

f) The Signal Key, released by operation *e*) has been used to unlock the required Home Signal.

Under normal conditions, the Ground Frames are locked with Keys D and L in the Hepper Transmitters.

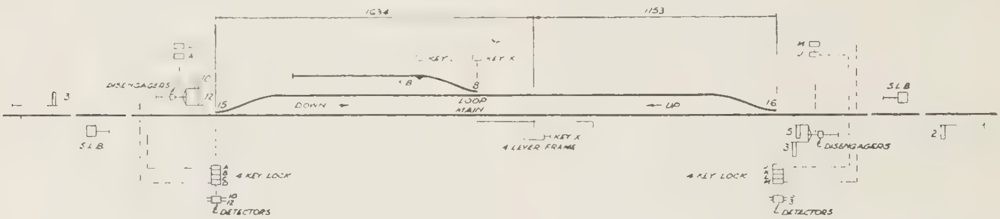


Fig. 1. — « B » class station H. E. H. Nizam's State Railway.

Shunting between the Shunt Limit Board (S. L. B.) and the Outer Signal is permitted by memorandum from Station Master to driver stating that no train is approaching from the next station or that the approaching train has been brought to a standstill at the Outer Signal.

4.2.2. — *Bombay, Baroda and Central Indian Railway*. (See Figure 2.)

In this system, ground frames are provied at either end of the station for the operation of points and a lever frame, centrally situated, is used for the operation of the fixed semaphore signals.

The necessary interlocking between signals and points is achieved through the use of Hepper Key Transmitters, the Ground Frames, the Station Master's Slide Control

To change the setting of the points, the following must be done :

a) Slide 31 is unlocked;

b) Hepper's Slides 29 and 32 are pushed home and the keys D and L are released;

c) Ground Frames are unlocked by keys D and L;

d) Slides are pulled for the point setting desired;

e) Points are reset as ordered and the particular points keys A—O, B—N or C—M, are reversed ;

f) Hepper's Keys D and L withdrawn and transmitted electrically to station;

g) Hepper's Slides 29 and 32 are pulled;

h) Slide for Signal desired is pulled;

i) Signal is unlocked and operated.

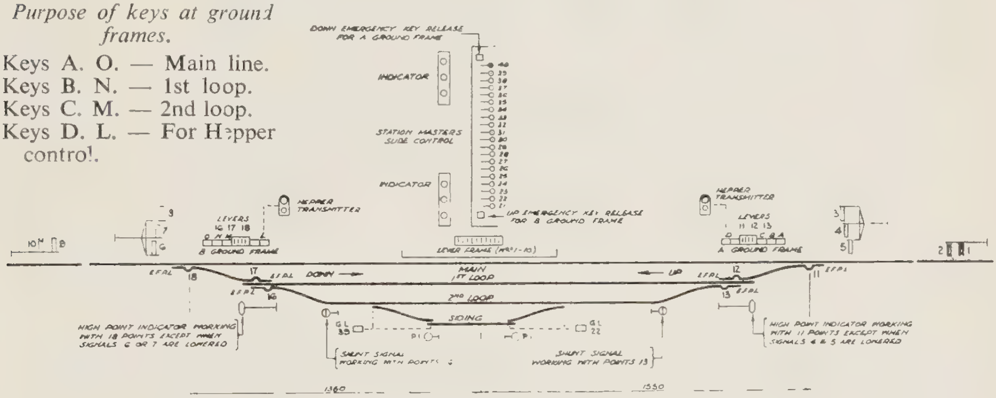
4.2.3. — *Egyptian State Railways.*

At type « A » Stations, signals are not interlocked and points are locked by keys which are held normally by the Station Master. Distant Signals are provided at 2 130 ft. approximately from the facing points. Up and down signals are installed at the centre of the station. Points on running lines are equipped with facing point locks and locking bars.

provided but a white board, approximately 8 ft. × 3 ft., known as a Warning Board, is placed 2 400 ft. from the facing points of either an Interloop or a Station. Warning Boards afford rear end protection to trains between them and the clearence marker at the far end of the loop from a point 600 ft. within them. The points, which are operated by hand tumblers are locked by padlocks attached to chain bridles.

Purpose of keys at ground frames.

Keys A. O. — Main line.
Keys B. N. — 1st loop.
Keys C. M. — 2nd loop.
Keys D. L. — For Hepper control.



Station masters slide control.

Key. — Up emergency « A » ground frame
Slide 21 spare.
» 22 goods siding points, east.
» 23 points setting, up 2nd loop.
» 24 for no. 5 signal.
» 25 points setting, up 1st. loop.
» 26 for No. 4 signal.
» 27 points setting, up main.
» 28 for No. 3 signal.
» 29 up heppers control.
» 30 Warner signals.
» 31 S. M's lock up.
» 32 down heppers control.
» 33 for No. 8 signal.
» 34 points setting, down main.
» 35 for No. 7 signal.
» 36 points setting, down 1st. loop.
» 37 for No. 6 signal.
» 38 points setting, down 2nd loop.
» 39 goods siding points, West.
» 40 spare.
Key. — Down emergency « B » ground frame.

Fig. 2. — Typical station Bombay, Baroda and Central Indian Railway.

4.3. — *Non-interlocked systems.*

4.3.1. — *South African Railways.*

a) *Branch Lines.*

On branch lines or other lines where the train service is light, fixed signalling is not

b) *Interloops.*

On lines other than those mentioned in the previous paragraph, Warning Boards are provided, and the facing points are equipped with locking bar, hand operated tumbler, which is bridle locked and secured

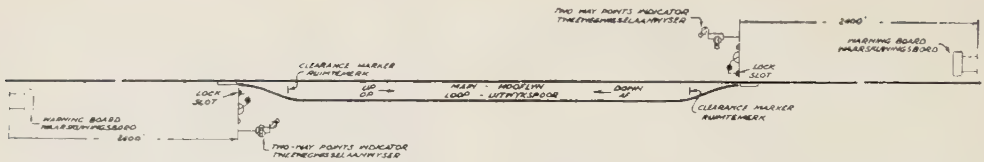
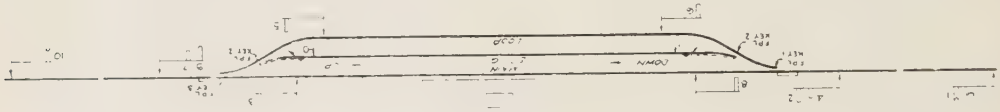


Fig. 3. — Interloop South African Railways — Tussenuitwykspoor, Suid-Afrikaanse Spoorwee.

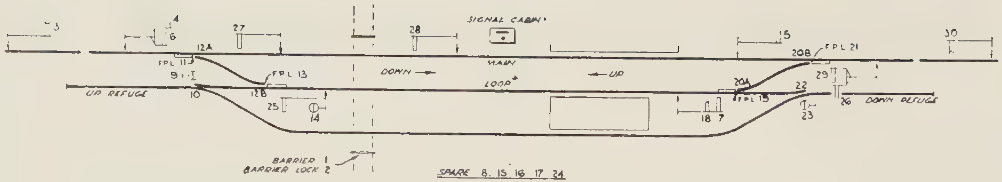


No.	Released by	Locks	Releases
Key 1		2. 8.	4. 6.
Key 2		2. 3. 4. 5. 6. 7. 8. 9.	
1	2. 3.		
2		5. 7. 8. 9. Key 1. Key 2.	1.
3		4. 8. 9. Key 2. Key 3.	1.
4	Key 1	3. 6. 7. 9. Key 2.	
5	Key 3	2. 6. 7. Key 2.	
6	Key 1	4. 5. 9. Key 2.	
7	Key 3	2. 4. 5. 8. Key 2.	
8		2. 3. 7. Key 1. Key 2.	10.
9		2. 3. 4. 6. Key 2. Key 3.	10
10	8. 9.		
Key 3		3. 9.	5. 7.

Fig. 4. — Type c station Egyptian State Railway.

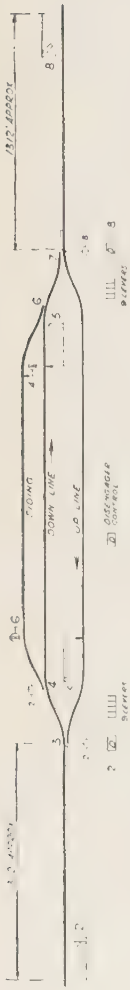
for the through line, and a Two Way Points Indicator. This latter piece of mechanism consists of two small semaphore arms each mounted on a white disc. When the points are normal and the switches are closed correctly, the higher arm moves to the « off » or upwardly inclined position, whilst the arm for the loop is in the horizontal position and only moves to the « off » position when the points have been reversed and are correctly closed.

The apparatus is trailable without damage except to the bridle chain but if such a set of points is trailed through, both indicator arms assume the horizontal position.



No.	Released by	Locks	Releases	No,	Released by	Locks	Releases
1	2.			18	19. 22.	6. 14. 25. (10. 12. 13 B/W)	
2		4. 6. 9. 23. 26. 28. 29.	1.	19		23. 26. (20 B/W)	6. 7. 18.
3	4. 5.			20		5. 22. 29.	7. 26.
4	11.	2. 7. 12. 26. 29.	3.	21		5. 7. (20 B/W)	26. 29.
5		20. 21. 27. 28. (11. 12. B/W)	3.	22		20.	18. 23.
6	11. 12. 19.	2. 13. 18. 29.		23	22.	2. 9. 19.	
7	19. 20.	4. 14. 21. 25. (10. 12. 13. B/W)		25	12. 13.	7. 11. 18. 29. (19. 20. 22 B/W)	
9	10.	2. 13. 23.		26	13. 20. 21.	2. 4. 14. 19.	
10		12.	9. 14.	27		5. 11. 12.	30.
11		25. 27. 28. (12. B/W)	4. 6.	28		2. 5. 11. 12. (20. 21 B/W)	30
12		4. 10. 27. 28.	6. 25.	29	21.	2. 4. 6. 20. 25.	30
13		6. 9. (12. B/W)	14. 25. 26.	30	27. 28. 29.		
14	10. 13.	7. 8. 26. (19. 20. 22. B/W)					

Fig. 5. — Type E station Egyptian State Railways.



Description	Released by	Work	Locking
Down home signal.		2	3. 4. 5.
Down facing points		3	2. 4.
Down siding facing points.		4	2. 3. 9.
Up starting signal	3.	5	
Disc from siding	4.	6	
Control on up home. . . .		9	2. 4.

Description	Released by	Work	Locking
Control on down home . .		1	6. 8.
Disc from siding	6.	4	
Down starting signal. . . .	7.	5	6.
Siding points	7.	6	1. 5.
Up facing points		7	8.
Up home signal		8	1. 7.

Fig. 6. — Sudan Railways standard signalled station. Type (*a*).

The speed of trains for the through line is limited to 35 m. p. h. and over the turnout to 20 m. p. h.

A typical interloop is shown in Figure 3.

4.4. — *Interlocked Systems.*

4.4.1. — *Egyptian State Railways.*

At stations of types « B » and « C », the arrangements are :

a) Signals. — Distant, Home and Starting;

b) Points. — Key locked and provided with facing point locks and locking bars when on the main line but without lockbars when on the loop;

c) Full interlocking is provided between signals and points keys.

Figure 4 shows a type « C » layout.

At stations, types « D » to « H », full interlocking is provided with operation of points and signals from a centrally situated lever frame.

Figure 5 shows a type « E » station.

4.4.2. — *Sudan Railways.*

There are three main types of mechanical signalling viz :

(*a*) Standard signalled.

(*b*) Fully signalled.

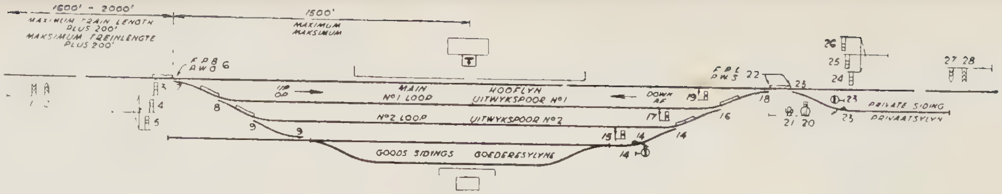
(*c*) Non-fully signalled.

Type *a*) is shown in Figure 6. A single centrally situated lever frame may be provided for the operation of all points and signals as an alternative to the two frames.

Type *b*) is as for type *a*) but Inner Home Signals are provided at 15 metres (41′ approx.) from the facing points. The Outer Home Signal levers are released by the Inner Home Signal levers. Such signalling exists at the larger stations where loops are signalled in and out.

Type *c*) stations are simpler than Type *a*). Home signals are provided as in Type *a*) with points indicators on the main line facing points. Leaving signals and discs are not provided.

Facing points on running lines are fitted with facing point locks wherever lever frames are provided.



Key D and lever 10 for switching out. *Levers* 11.12.13 *Spare.*

Released by	No.	Locking	Released by	No.	Locking
3. 2. 20. 19.	1			18	3. 19. 26.
(3 or 4 or 5)	2		(20 or 21)	19	18.
6.	3	7. 18. 23.	22.	20	14/14 16/16 23 24 25 (26 W 10 N)
18. 7. 6.	4	8. 16. 23.	23. 22.	21	14/14. 16/16.
16. 8. 6.	5	9. 14. 23.		22	18/18. 23/23.
	6	7/7. 24. 25. (26 W 10 N)		23	3. 4. 5. 20. 24. 25. 26.
	7	3. 26.	8. 16. 22.	24	6. 9. 14. 20. 23.
7.	8	4. 25.	7. 18. 22.	25	6. 8. 16. 20. 23.
8.	9	5. 24.	22.	26	7. 18. 23. (6. 20.W 10 N)
Key D 1. 28.	10		(24 or 25 or 26)	27	
16.	14	5. 15. 24.	26. 27.	28	
16 (20 or 21)	15	14.			
18.	16	4. 17. 25.			
18 (20 or 21)	17	16.			

Fig. 7. — Special interlocked station. — South African Railways.

4.4.3. — *British Railways.*

Signalling at single line stations consists of Distant, Home and Starting signals. Unfortunately no typical station layouts are available.

4.4.4. — *South African Railways.*

Signalling is classed as « Interlocked » or « Interlocked Special ». In the latter, Distant Signals are provided for the Main Line through trains with facing point bolts on all main line points.

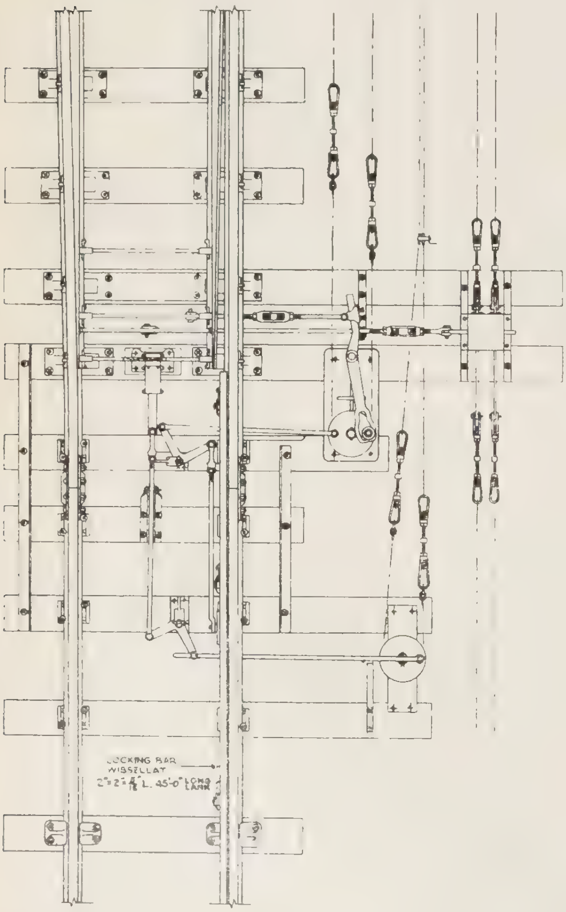


Fig. 8. — S. A. R. Facing points layout (with lock bar and independent F. P. bolt operated by double wire).

Under « Interlocked » signalling the maximum speed on the Main Line is 35 m.p.h. whilst under « Interlocked Special » signalling the maximum speed is 45 m.p.h. Speeds over points when set for the turnout are limited to 20 m. p. h.

Figure 7 shows a typical station of the « Interlocked Special » class.

It will be noted that no Starting Signals are provided. Signal 20 is a Route Signal and is provided to prove that points 23 are normal whilst Shunt Signal 21 is provided to ensure that points 23 have reversed correctly. The Dwarf Signals 15, 17, 19 are to ensure that a driver for whom Signals 20 or 21 have *not* been operated will not move.

As private sidings are infrequent in the position shown, the average station will not have the signals and points Nos. 15. 17, 19, 20, 21 and 23, in which case 22 would be a Facing Point Bolt. In the « Interlocked » class, signals 1 and 28 and Facing Point Bolts 6 and 22 would not be provided.

The Outer Home Signals 2 and 27 are « stop and draw in » signals when at danger. A driver may not pass them in the danger position unless the line as far as the respective Home Signals is unoccupied.

Shunting in the face of oncoming trains is permitted within the Outer Home Signal when at danger.

No. 14 derail is equipped with an Indicator past which, when it is at « caution » (yellow light at night), a movement may be made only under hand-signal.

Most stations are provided with devices for switching out the station when all main line signals are operated after lever 10 has been released and pulled half-over. The signals are then locked in the « off » position by completion of the stroke of No. 10 which in turn is locked reverse by removal of Key D.

Under closed conditions, all lights are extinguished.

A station may close, provided the sections either side are clear of trains. Token working is then suspended and Telegraph Order

Working introduced over the extended sections.

Points are operated by double wire using No. 6 s. w. g. wire. Outer Home and Distant Signals are operated by double wire whilst all other signals are operated by single wire; No. 10 s. w. g. wire is used for signals. Double wire operated signals are provided with special cranks which, if a wire breaks, renders impossible the operation of the arm to the « off » position.

Figure 8 shows a typical layout for a wire-operated set of points.

b) *Interurban lines.*

Two position Arrival Signals, track controlled;

Three position Departure and Intermediate Signals, track controlled on Absolute Permissive Block principle between loops.

See Figure 10.

c) *Interstate lines.*

Two position Arrival and Departure Signals;

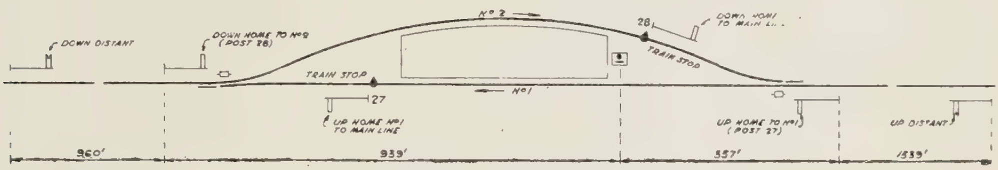


Fig. 9. — Suburban passing station Victorian Railways.

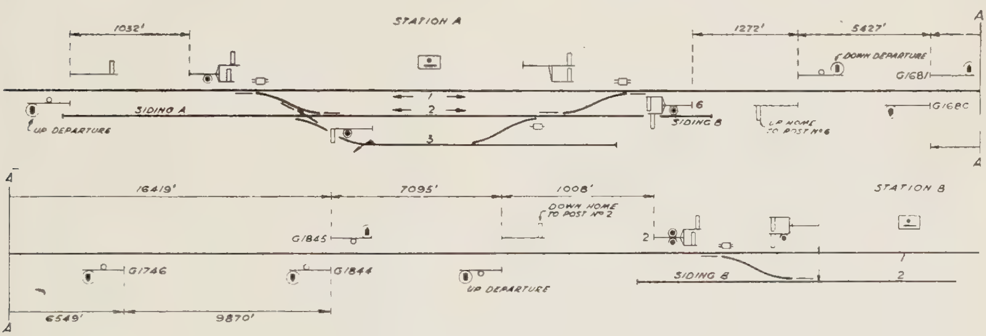


Fig. 10. — Typical station and section arrangements interurban lines Victorian Railways.

4.4.5. — *Victorian Railways.*

The signalling on these railways is varied according to the type of line and is divided roughly into the following categories with the equipment shown below :

a) *Suburban lines.*

Two position Arrival and Departure Signals, lever locked and track controlled between passing loops.

See Figure 9 for a typical arrangement.

Arrival signals are track controlled. Electric Train Staff is in use between loops.

See Figure 11.

d) *Country branch lines.*

Two position Arrival Signals with Train Staff and ticket between loops.

Train Stop protection is provided for electric trains at track controlled power operated Departure Signals.

4.4.6. — *Pennsylvania Railroad.*

Details of typical single line stations with mechanical signalling are not available and it would appear that the policy is to change over from mechanical semaphore signalling to light signals of the position or colour-light type.

This is understandable when the enormous expansion of signalling projects in the U. S. A. is considered. Reference to Table « A » will show that loads dealt with are very much in excess of those conveyed on the other railways under discussion. Mechanical operation of points and switches for an average goods train would be impossible from a centrally situated lever frame and the choice would then be between a multiplicity of signal cabins or concentration of functions under a limited number of operators.

The choice has been in favour of the latter and this has influenced the whole trend of signalling in the U. S. A. where methods have been adopted which are quite foreign to many railway organisations in other countries. It is not surprising, therefore, to find that the signal indications are quite different from those generally in use elsewhere. The Absolute Permissive System in use on the Victorian Railways is the nearest approach to the systems in use on the Pennsylvania Railroad.

The development which has taken place on this and other railways in the U. S. A. seems to be a logical expansion of the centralising theme and appears to have developed more or less in the following order :

a) hand operation;

b) mechanical operation;

c) the Absolute Permissive Block System;

d) electrical operation of points and signals;

e) the use of centralised traffic control.

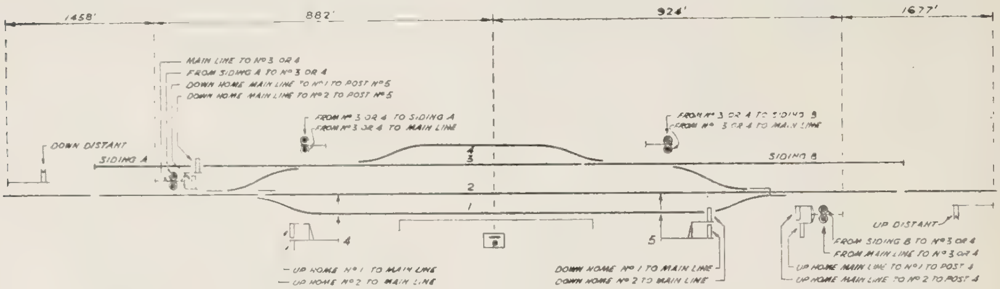


Fig. 11. Typical passing station on interstate line Victorian Railways.

Under the last mentioned, most of the aims and objects of Signalling and Operating officers have been achieved.

These, briefly, are the ensuring of :

a) the greatest margin of safety;

b) the quick transit of trains with constant supervision of movements.

The adoption of Centralised Traffic Control has had the effect of simplifying the layout of stations, since the planning of future traffic movements avoids bunching of trains and hence reduces the accommodation necessary at stations. The layouts become simplified in the extreme and are reduced in many instances to a main line and a loop only.

The signalling aspects used, cover not only such movements as Stop, Stop and Proceed, Proceed, but qualify proceed indications with reference to speed.

Figure 12 shows the various indications and meanings, whilst Figure 13 shows an actual example of single line signalling under C. T. C.

This paper is, however, not the place for a detailed discussion on the methods of control and operation of functions under this class of signalling.

A few notes on the signalling shown in Figure 13 are not out of place, however.

When a switch is reversed, and the signal is operated for a train to enter a loop, which is unoccupied, the distant signal to the siding displays the Approach -- Medium aspect, Rule 282, which indicates «proceed, approaching next signal at medium speed ».

The Home Signal displays the Medium - Clear aspect, Rule 283, which indicates « proceed, medium speed within interlocking limits ».

When a train is due to depart from a loop, with no train ahead for two or more blocks, the points are reversed and the departure signal displays the Medium Clear aspect. When the rear of the train is past the points, the speed of the train may be accelerated to the authorised speed. If a preceeding train has cleared only one block, the departure signal will display the Slow Approach aspect.

5. — Signalling between stations.

The Victorian Railways and the Pennsylvania Railroad, as will be seen from foregoing notes, utilise signalling between stations or passing loops. None of the other organisations appear to do so with the exception of the South African Railways which has only one example of intermediate automatic signals on a single line section.

Where the distance between interlockings is short, this later railway dispenses with token control and provides track controlled mechanical signals with release lever operation.

6. — Cab signalling.

The Pennsylvania Railroad utilises cab signalling with audible warning devices on certain trains and in certain areas.

7. — Signalling equipment out of order.

7.1. — *Signals Out of Order.*

On the Pennsylvania Railroad written instructions are issued authorising drivers to pass defective signals at danger.

Hand signalling past defective semaphore signals is resorted to on the other railways under discussion. On H. E. H. The Nizam's Railway, drivers must be piloted in from the outer signals.

7.2. — *Token Instruments Out of Order but Communications in Order.*

When Token Instruments fail, the particular system of block telegraph system used is introduced except on the British Railways when pilot working is put into force.

On the Sudan Railways, the tickets under « Line Clear » ticket method of working must be endorsed to the effect that the token instruments are out of order.

On the South African Railways all trains must be stopped to ensure correct delivery of telegraph orders.

7.3. — *Token instruments and communications failed.*

Under these conditions, pilot working is introduced on the Egyptian Railways.

On the Sudan Railways, trains may run during hours of darkness under pilot working. During daylight hours, use has to be made of the nearest telegraph office for transmission of the « Is Line Clear » message.

On the South African Railways, « Telegraph Failed » orders are used or in certain areas, pilot working is introduced. Under the former method, the operator who has the right to despatch the first train and has not received the « Train Arrived » signal for the preceding train, must not despatch a train on a « Telegraph Failed » order until the preceding train has had time to reach the next station.

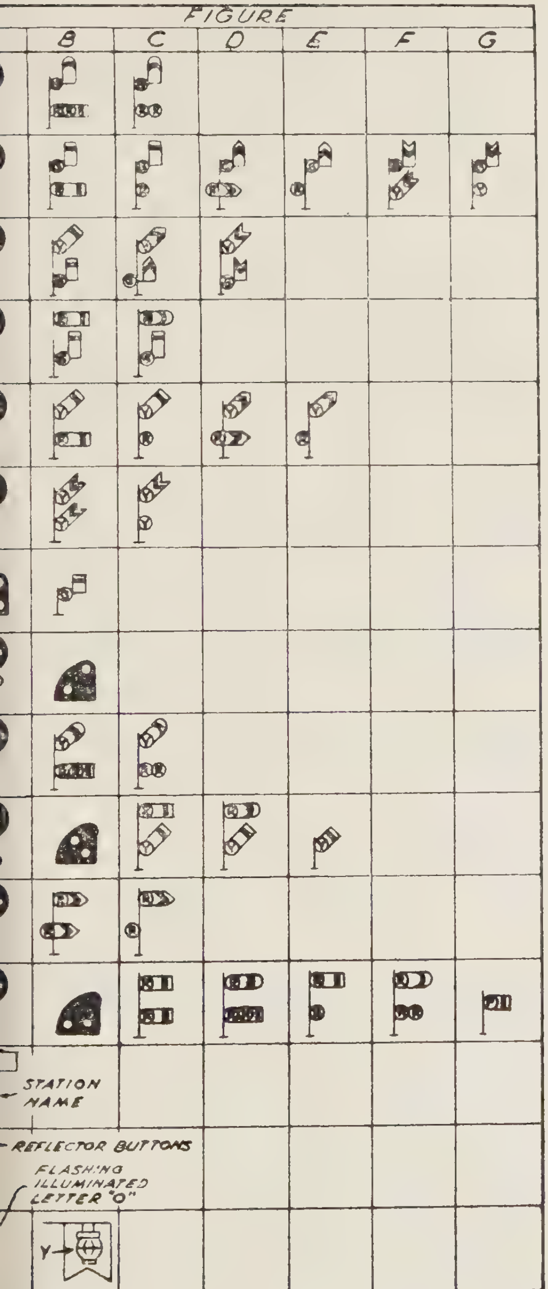
8. — Operation of light signals.

8.1. — *Variation of Supply Voltage.*

The Victorian Railways provide for correct operation with a $\pm$ 10% variation

Rule	Indication	Name
280	Proceed: manual block clear	Clear-bloc
281	Proceed	Clear
282	Proceed approaching next signal at medium speed.— Note: trains may proceed approaching next signal at not exceeding 45 miles per hour at signals displaying a yellow triangle outlined in black	Approach-m
283	Proceed; medium speed within interlocking limits.— Note: trains may proceed at not exceeding 45 miles per hour at signals displaying a yellow triangle outlined in black	Medium-cle
285	Proceed prepared to stop at next signal. Train exceeding medium speed must at once reduce to that speed	Approa
285A	Train exceeding medium speed must at once reduce to that speed. Where a facing switch is connected with the signal, approach that switch prepared to stop. Approach next signal prepared to stop	Cautio
287	Proceed; slow speed within interlocking limits	Slow-cle
288	Proceed prepared to stop at next signal. Slow speed within interlocking limits.	Slow-appr
289	Block occupied; for passenger trains, stop; for trains other than passenger trains, proceed prepared to stop short of a train or obstruction, but not exceeding 15 miles per hour	Permissive-
290	Proceed at restricted speed	Restrict
291	Stop; then proceed at restricted speed. Note : Freight trains of 90 or more cars or having tonnage of 80 % or more of the prescribed engine rating may proceed at restricted speed without stopping at signals displaying a yellow disk on which is shown the tetter G in black.	Stop-and-p
292	Stop	Stop-sig
293	Limit of the block. Note - Fig. A yellow light to be deplaced next to track governed	Block-l
293A	Proceed prepared to stop at next block-limit signal. Train exceeding medium speed must at once reduce to that speed. Note: Will not apply to trains authorised to pass block-limit station as though clear-block signal were displayed.	Approach limi
294	Orders. Note. — Fig. A. — To apply to trains governed by fixed signal with which connected. Note. — Fig. B. — By day the yellow lamp is not displayed	Train-o

Fig. 12. — Pennsylvania.



rd signal aspects.

Note. — In the illustration of typical aspects, rules 280 to 294 inclusive :

R — Red.
P — Purple.
Y — Yellow.
G — Green.

Speeds :

Medium speed. Not exceeding one-half the speed authorised for passenger trains but not exceeding 30 miles per hour.

Reduced speed. Prepared to stop short of train or obstruction.

Slow speed. Not exceeding 15 miles per hour.

Restricted speed. Not exceeding 15 miles per hour prepared to stop short of train, obstruction or switch not properly lined and to look out for broken rail.

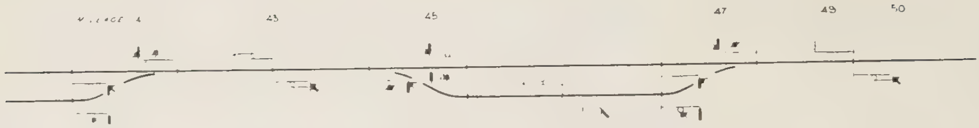


Fig. 13. — Pennsylvania Railroad (single line C. T. C. operation).

in voltage whilst the Pennsylvania Railroad allows ± 20 %.

8.2. — *Conflicting departure signals.*

Where Manual Block working is in force, it is not impossible for opposing signals to be operated simultaneously, but with Absolute Permissive working, this is impossible.

Where token control between stations is in force, there is no interlocking between departure signals and hence it would be possible for the signals at both ends of a section to be operated simultaneously, but as the token is the major authority to proceed, this is not a serious matter.

9. — Maintenance.

In all cases, the replies indicate that the maintenance of assets is considered to be of prime importance and elaborate instructions are issued to ensure continuity of service and safety of operation.

It is not possible to quote these instructions, which vary according to the complexity of the type of signalling in use, but the instructions issued by the Pennsylvania Railroad might well serve as a model. Not only are the various testing methods specified in detail but, for all classes of apparatus it is laid down by whom the tests shall be made and at what intervals.

10. — Installation and maintenance costs.

In view of the diversity of signalling methods, it is quite impossible to bring to a common basis the costs either of installation or maintenance of signalling assets.

As a matter of interest, however, the following figures are quoted. They are given, unless otherwise specified, per kilometre :

	Installation	Maintenance P.A.
Sudan Railways	No figures	available.
British Railways	£ 3 000	£ 60
H. E. H. The Nizam's State Railway (per station)	R. 11 000	R. 680
Bombay, Baroda and Central Indian Railway (per station including telephones and token instruments)	R. 1 000 000	R. 800
Egyptian State Railways	£ 400	£ 50
Victorian Railways :		
Suburban	£ 9 000	£ 360
Interurban	£ 11 000	£ 440
Interstate	£ 9 000	£ 180
Branch	£ 600	£ 10
Pennsylvania Railroad :		
Automatic Block	$ 3 600	$ 196
C. T. C.	$ 7 000	$ 420
South African Railways :		
(per station)	£ 4 000	£ 250

11. — Conclusions.

It is hoped that the information contained in this article may be of some interest but it is realised that it is quite impossible to give all the facts and details of each differing system of signalling. It is considered each warrants individual treatment with which should be given not only the details but the reasons underlying the adoption of the particular system.

Unfortunately this is not possible. Not only is all the information requisite not available to the writer but if it were, the resultant comparatively lengthy treatise on the subject would probably defeat its object by inducing in the reader a sense of boredom.

It should be realised that the replies received represent only a portion of the existing differing systems of signalling on single lines and it will be apparent that whilst there is a distinct dissimilarity between some of the systems, those employing the use of mechanical semaphore signalling are definitely related, the one to the other. The differences are essentially of detail. One system may have developed somewhat further in a certain direction than another but obviously all systems are based on a common foundation.

Deviation from and development of detail would appear to have been dictated by local influences and without doubt these include climate, topography, type of personnel and finance.

It would seem that where there is an abundance of not too costly labour, development of signalling from the more simple to the more complicated is retarded. This may well be one of the reasons why on the Pennsylvania Railroad and the Victorian Railways there is a decided development from the earlier traditional semaphore signalling. There are no doubt other reasons but the writer does not consider himself competent to advance any. This can be done only by those who are aware of all the underlying factors which have influenced progress. Obviously opinions of this nature should come from those actively engaged in the management of each railway organisation, and perhaps it would not be out of place to suggest that, at some future date, each organisation might with advantage to all give the reasons why development has taken place in one direction and not in another.

SUMMARY.

1. — General.

1.1. — This paper has been divided roughly into two main sections, viz :

a) The control and/or signalling of the single lines between crossing stations or crossing places.

b) The signalling of the crossing loops or stations.

2. — Control of single lines between crossing places.

The methods of control are :

a) Token working;

b) Telegraph order working.

c) Time table working and train orders.

d) Manual block.

2.1. — *Token Working.*

Generally, token working is in use under the Absolute Method except on certain sections of the Victorian Railways where the Electric Train Staff and Ticket system is in vogue and on the South African Railways where the tablet permissive and crossing system is in extensive use.

On the latter Railway tablet pouches of differing shapes are used and under permissive working drivers are given full details of the nature of the token, of preceding trains and what trains are following.

The South African Railways appear to be the only organisation which carries out crossings at unattended places under token working when in the case of certain trains restrictions are placed on the number of trains which may cross.

2.2. — *Telegraph Order Working.*

Telegraph order working is used fairly widely especially in cases where stations are switched out or when token instruments are out of order but the tendency is to replace this method by token working.

2.3.— *Time Table Working and Train Orders.*

On the Pennsylvania Railroad the time table is often used either alone or in conjunction with Train Orders for the running of trains on single lines.

2.4. — *Manual block.*

The Manual Block method of working is in common use on the Pennsylvania Railroad.

3. — Signalling at stations and passing loops.

The main divisions of signalling may be divided roughly into three classes, viz :

a) Key locking Systems;

b) Interlocking Systems;

c) Controlled light Systems.

3.1. — *Key Locking Systems.*

These systems vary considerably in detail from places where the minimum of signalling is provided in the form of locked facing points protected by Warning Boards, as on the South African Railways, to complete interlocking of signals with control of points by keys as on :

H.E.H. The Nizam's State Railway,
Bombay, Baroda & Central Indian Railway,
Egyptian State Railways.

Under key locking systems utilising signals, the methods of control between signals and points are interesting.

The range is from that where the keys are retained by the station master and there is no interlocking between points and signals to that where the method adopted involves the use of three lever frames, with station master's slide control and Hepper's Key Transmitters. This latter method is used on the Bombay, Baroda and Central Indian Railway.

Falling within the category of key locked crossing loops are the « interloops » of the South African Railways where the facing points are locked and equipped with two way indicators and protected by warning boards.

3.2. — *Interlocked Stations.*

The majority of railway organisations use Distant, Home and Starting Signals with fully interlocked points and with facing point locks.

The South African Railways make provision for a class of signalling which does not use facing point locks in which case Distant Signals are not used. Starting signals are not provided at installations controlled by this organisation.

Usually the Home Signals are situated fairly close to the outermost facing points but in one class of signalling on the Sudan Railways, these signals are sited approximately 1 312 feet from the points. This organisation, in another class of interlocked signalling, uses two lever frames which are connected by disengagers.

On their Suburban and Interstate lines the Victorian Railways use the conventional signals mentioned in the first paragraph of this section with track control of the signals. Where the Departure or Starting signals are power operated, train stops are provided.

4. — Signalling between stations.

On the Pennsylvania Railroad and on the Interurban Lines of the Victorian Railways, permissive light signals are provided. On the latter railway the Departure Signals are three position track controlled as distinct from the semaphore signals at stations.

5. — Pennsylvania Railroad.

Details of mechanical signalling are not, available. Because of the great length of trains, which is far in excess of those hauled

on the other railways under discussion, development has been in the direction of centralising control with remote operation of points and signals. The Centralised Traffic Control System is in use largely on this railroad. Colourlight or position light signals are used in such combinations as to provide indications as to the speed to be adopted by drivers.

6. — Remote control of crossing loops.

Remote control of crossing loops is an integral feature of the Centralised Traffic Control System in force on the Pennsylvania Railroad.

The Victorian Railways likewise control such places remotely but not under the C. T. C. method.

7. — Cab signalling.

Cab Signalling is in use on certain sections of the Pennsylvania Railroad.

8. — Setting back of single lines.

Except in the case of ballast trains or in emergencies involving accident, setting back movements may be made only if absolute working is in force.

9. — Breakdown or accident.

In all cases provision is made for a relief train to enter an occupied section in which there is a disabled train after certain safeguards have been taken.

10. — Signals out of order.

On the Pennsylvania Railroad, written instructions must be given to drivers to pass defective signals. Elsewhere, pilot working or handsignalling must be resorted to.

11. — Token instruments out of order.

When token instruments fail, the particular system of block telegraph working used is introduced except on the British Railways when pilot working is put into force.

12. — Maintenance.

All railway organisations pay particular attention to the maintenance of signalling gear and elaborate instructions are in force to cover this.

13. — Installation and maintenance costs.

Because of differing classes of signalling, it is impossible to give costs on a common basis but those available are quoted in the report.

[**625** .614 & **656** .27]

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

15th. SESSION (ROME, 1950).

QUESTION XIII.

Modernisation of the maintenance methods of the permanent way on the light railways.

REPORT

(America, (North and South), Burma, China, Egypt, Great Britain and North Ireland, Dominions, Protectorates and Colonies, India, Iran, Iraq, Malay States and Pakistan).

by J. R. FARQUHARSON, C. B. E., B. Sc., A. M. I. C. E.,
Chief Engineer, East African Railways & Harbours.

TABLE OF CONTENTS.

Scope of the report.

This report deals with the methods which have been or are being adopted to maintain secondary lines. It is difficult to define « secondary lines » with precision but in general this report is concerned with the lesser important lines of heavy traffic systems and systems which can be regarded as secondary because of gauge, weight of permanent way or volume of traffic. The organisation of maintenance forces, the maintenance methods, the modernisation of equipment and the results achieved to date are discussed.

Source of the report.

Questionnaires were issued to twenty-six railway organisations. Detailed replies were received from eight railways. These are listed in Table I together with the route mileages, by gauges, to which they refer.

While the number of reporting railways is small the replies cover a wide range of climatic, traffic, economic and social conditions.

I. Staff : Modernisation of the organisation of gangs.

a) *Composition of gangs.*

1. Small section gangs are used by all railways and generally these form the basic maintenance force. British Railways, Victorian Railways and the South African Railways also use larger gangs to maintain longer sections while the Pennsylvania Railroad provides large extra gangs during the period of heavy maintenance. In the less developed countries long sections have been tried only as an experimental measure.

2. Practically all the replies received regarding the strength of gangs deal only with lines used for both passenger and

TABLE I.

RAILWAY	Mileage of gauges						Total route mileage
	5′ 6″	5′ 3″	4′ 8½″	3′ 6″	Metre	2′ 6″	
Pennsylvania Railroad	—	—	—	—	—	—	—
British Railways	—	—	7 515	—	—	—	7 515
Victorian Railways	—	7 973	—	—	—	124	8 097
Railway Board, India	2 792	—	—	—	—	925	3 717
H. E. H. The Nizam's State Railway	693	—	—	—	698	—	1 391
South African Railways	—	—	—	5 000	—	—	5 000
Sudan Railways	—	—	—	2 020	—	—	2 020
East African Railways	—	—	—	—	2 931	—	2 931

goods services. The typical arrangements for the lines with a gauge of 4′ 8 1/2″ and upwards are shown in Table II.

For the lines of less than standard gauge the typical arrangements in force are summarised in Table III.

A study of the two tables reveals the wide disparity in the labour strength per mile. As would be expected the railways in the more advanced countries are able to maintain the permanent way with fewer men. Only the South African Railways appear to have been able to achieve a considerable reduction in manpower by the use of larger gangs responsible for longer sections; as noted later these longer sections are less intensively maintained.

3. The principal factors determining the number of men per mile are density and speed of traffic, axle loads, the type, strength and condition of track, the nature and quantity of ballast, the amount and degree of curvature, the climate and the nature of the formation.

4. A maintenance gang is generally composed of a gang foreman with from two to fifteen (usually four to ten) trackmen. The gang foreman is responsible for the maintenance of tracks and the railway reserve on his particular section and for the safety of his men. The standard section gangs on the Pennsylvania Railroad are increased during the working season. Other railways make no regular seasonal increases; gangs are strengthened or additional temporary gangs employed for such extra work as re-sleepering, pulling creep, re-aligning curves or overtaking arrears of maintenance.

TABLE II.

RAILWAY	Length miles	Maximum axle load		Maximum speed m.p.h.	Small gangs			Large gangs		
		Locos tons	Wagons tons		No. of men E.	Length miles L.	Strength per mile E/L.	No. of men E.	Length miles L.	Strength per mile E/L.
Pennsylvania	—	35.7	22.3	50-70	8	12	0.67 (1)	—	—	—
British	7 515	22.5	18	45-60	5	6	0.84	8/9	10.5	0.75 to 0.84
Victorian	7 973	14.5	14.5	40	4	10	0.40	5	14	0.36
India	2 792	21.9	22.4	60	8	3	1.67	—	—	—
Nizam's	693	18.5	16.0	60	8	3	1.67	—	—	—

(1) On lines with passenger services only 0.58, on lines with goods services only 0.50.

b) *Where the staff live.*

5. In the well populated countries staff live in their own houses conveniently near the gang headquarters. In thinly populated regions staff usually live in railway houses at the gang headquarters.

6. On the Pennsylvania Railroad and British Railways practically no housing is provided. On the Victorian Railways about 12 % of the staff are housed while in India about 40 % are housed, the balance finding accommodation in nearby villages. On the Sudan and East African Railways housing is provided at gang headquarters. No

reporting railway advises that wives act as crossing keepers or station masters.

c) *Transport of staff.*

7. Where staff live some distance from the gang headquarters they are required to make their own arrangements and report at headquarters at the starting time. Cycle tracks are not provided alongside the track; in some cases trackmen can reach the point of work by cycling on adjacent roads. Only in a few special cases (e.g. fog signalling or snow storm duty) are allowances paid for trackmen when they use their own machines.

8. Where traffic conditions and the limits of visibility permit, the Pennsylvania Railroad, British Railways, Victorian Railways and the South African Railways (on their longer sections) use petrol motor trolleys. The characteristics of the units used by the three last named organisations are shown in Table IV. The Pennsylvania Railroad uses passenger trains in metropolitan areas and buses where road access can be obtained.

The Victorian Railways use manually operated tricycles (one man) and quadricycles (4 men) and the South African Railways push trolleys on their shorter sections, while the Sudan Railways use manually operated pump trolleys which can carry up to 11 men and their tools. On the other railways the staff always walk to the place of work; this method often applies, of course, on the other railways where motorised or manually operated vehicles are used.

TABLE III.

RAILWAY		Length miles	Maximum axle load		Maximum speed m.p.h.	Small gangs			Large gangs		
			Locos tons	Wagons tons		No. of men E.	Length miles L.	Strength per mile E/L.	No. of men E.	Length miles L.	Strength per mile E/L.
Victorian		124	9.5	4.0	20	4	11	0.36	—	—	—
India		925	7.5	7.6	30	6	4	1.50	—	—	—
Nizam's		698	10.0	10.0	45	8	3	1.67	—	—	—
South African		5 000	11.6	11.6	25-45	6	8	0.75	12	24	0.50
Sudan		2 020	12.4 -16	12.4	31-44	10	12.4	0.81	—	—	—
East African	I	1 625	10-18	12	25-40	9	4	2.25	—	—	—
	II	1 306	10	12	25	10	5	2.00	—	—	—

9. Physical characteristics, traffic density and the desire to achieve economies determine the form of transport used. Motor trolleys are used on long sections to enable working time to be saved and so reduce the number of men per mile of track. The drawbacks of this method are *a*) the difficulty of obtaining line occupation, *b*) the difficulties and costs of maintenance and *c*) patrol of the line tends to be ineffective when the trolley travels at high speeds.

Manually operated trolleys have been developed for use on shorter sections. They can be removed from the line to allow trains to pass. They offer considerable advantages on easily graded lines with good visibility.

10. Generally motor trolleys are operated under the same rules as trains though in some cases they observe special block regulations which are clearly explained to employees who are periodically examined. The trolleys are taken off the track near the place of work. The Pennsylvania Railroad and South African Railways use portable telephones (the former sometimes uses radio), British Railways provide telephones and key instruments at run-off points while the Victorian Railways provide telephones at fixed locations. Manually operated trolleys are usually operated under special regulations. The gang foreman obtains permission from the station master and advice of the trains running before the trolley enters a section and on arrival at the site of work the trolley is removed.

TABLE IV.

PARTICULARS	Unit	*British Railways*	*Victorian Railways*	*South African Railways*
Power	H.P.	9-11	4-8	20
Capacity	men	10-12	2-8	12 (1)
Weight (unladen)	Cwts.	12.5-15	4-10	27
Speed	m.p.h.	20-25	20	30

(1) A trailer is usually attached.

d) *Measures intended to encourage staff to improve their output.*

11. While schemes for paying bonuses have been or are being considered, only the Victorian and Sudan Railways have schemes in operation. Under the Victorian Railways scheme sets of prizes are allotted for each district. The prize money is usually divided equally among the members of the gang. Points are awarded for line of track, surface of track, tightness of fittings, condition of cuttings and drains, cleaning, trimming and making up formation, weeding, trimming and regulating ballast and general improvements. No gang which has had the help of a special gang is eligible for a prize. One set of prizes is awarded for sections with rail over 75 lbs/yard and another for sections with rail of 75 lbs/yard and under. The prizes are :— first £ 55, second £ 30, third £ 15, and the most improved section £ 30. The effect of the awards has been to increase the interest of the gangs in their work and to improve standards of maintenance. On the Sudan Railways an award for the best section equal to 12.5 % of each employee's pay is awarded twice annually. The effect is difficult to estimate.

II. Modernisation of the actual maintenance methods.

a) *What up-to-date methods consist of.*

12. Among the reporting railways there has been, as yet, no great change in maintenance methods. On the Pennsylvania Railroad specialised mechanised gangs are being

used to carry out such heavy work as renewing rails, renewing ties and cleaning ballast. Sections not programmed for heavy work are covered by the section gangs. A rather similar policy is followed on British Railways. On the other railways it is usual to undertake a general revision of the track at regular intervals usually once a year; on the Nizam's Railway the interval is two years, partial revision being done once per year. On the long sections of the South African Railways maintained by motor trolley gangs systematic maintenance is considered impracticable.

13. As regards the period of the cycle for complete revision, the Pennsylvania Railroad reports that it is as short as two years on heavy traffic lines in mountain territory, the average cycle being five to six years. The British Railways report the cycle as 15 to 20 years on important lines and 30 to 35 years on lines of lesser importance. Both these railways have in mind the renewal of rails and/or sleepers either in new or second hand materials. The other railways have in mind purely maintenance revision which is usually undertaken each year; on these lines the lives of the rails and sleepers are usually very long.

14. On most railways section gangs undertake as required spot surfacing, lining, gauging, etc., on parts of the line not subject to a revision programme. Only the Nizam's Railway undertakes a regular partial maintenance revision covering the whole section once every year.

15. Practically all the lines under consideration are used for both passenger and goods services. Where lines carry goods services only, there is no difference in the methods used but in some cases rather less careful attention is given to the packing of the track.

16. The Pennsylvania Railroad, British Railways and Victorian Railways have provided details of the methods used when the renewal of rail is included in the revision programme. The Pennsylvania Railroad gives the following details of the operations :—

« 1. Clean ballast.
2. Apply new rail and fittings.
3. Raise track, install and space ties.
4. Apply additional ballast where required.

Step No. 1 is done by mechanical methods, usually preceding the laying of new rail.

Step No. 2 is performed by specialized rail laying gangs. These gangs are quartered in camp trains and travel over the system laying rail. They are highly mechanized, having machines to handle the rail, adze the ties, tighten the bolts, pre-bore the ties, drive the spikes, etc.

Step No. 3 is performed by Division extra gangs. As the track is raised the new ties are installed and the spacing of the ties in the rail panel is adjusted. Following the installation and spacing of the ties the track is tamped either by hand or by mechanical means and brought to correct alignment.

In Step No. 4, new ballast is applied and the job is completed by dressing the ballast and generally cleaning and dressing the right-of-way. »

The operations on British Railways and Victorian Railways are rather similar though not so highly mechanised.

The maintenance revision of other lines generally consists of — opening out the track, screening the ballast (when necessary), squaring and re-spacing the sleepers, tightening sleeper fastenings, aligning of track, packing of sleepers, oiling of fishplates and fishbolts, adjusting for creep, boxing of ballast to standard section, correcting of cess and clearing of side drains.

17. The partial revision carried out in the Nizam's Railway consists of opening out the track, packing each sleeper, correcting cross levels, weeding of the track and cess and rectifying the alignment.

18. Only the British Railways report the adoption of methods other than those described; namely the laying of pre-assembled track. It is described as follows :—

« Two Regions have produced track laying cranes which stand on one line and take up and lay in the track on an adjacent line at any interval up to 10′ 0″. Complete lengths of track up to 60′ 0″ long are lifted by the crane, simple « bails » being used for gripping the track to be lifted. Close co-ordination with the Operating Departments is essential for relaying with these cranes, as complete possession of one line is required and either complete or long-period « between trains » possession of the other.

The sequence of operations is as under (for say relaying 3/4 mile of track on double or multiple track lines) :—

All the new materials sent to a pre-assembly Depot beforehand. Complete rail lengths (60 ft. or 45 ft.) fabricated during the week preceding the Sunday and loaded by crane on to special rail wagons to 5 tiers high per wagon.

Special train of loaded and empty wagons run to the site on the Sunday.

Complete rail lengths of old track lifted out by crane and loaded on to empty wagons, sleeper beds broken up, ground levelled, new rail lengths of track unloaded by crane and lowered into position in the track.

Partial lifting of the track can usually be done on the day of relaying and of course no subsequent occupations are required for loading the recovered materials. »

b) *Details of application of the maintenance methods.*

A. *Maintenance of the rails and fishplates.*

19. Most railways deal with fishplate wear by fitting re-formed oversize cambered fishplates. Shims are used to some extent but generally give less satisfactory results.

20. No railway welds joints out on line as a regular practice though some experimental welding has been done in the past by the Thermit process.

21. The building up of frogs by either electric or oxy-acetylene welding is the usual practice on practically all railways. Only the Pennsylvania Railroad, Victorian Railways and the South African Railways build up rail ends; electric and oxy-acetylene welding are both used. The Pennsylvania Railroad deals with excessive end wear and battering by cropping the rails just beyond the limits of the fishplates. The Victorian Railways have successfully used flame-hardening on the ends of rails.

B. *Maintenance of the sleepers and their fastenings.*

a) *Wooden sleepers.*

22. When the coach screws or dogspikes become loose and cannot be tightened satisfactorily all railways plug the old holes and drill new holes. The Indian Railways use tight-fitting cylindrical wooden plugs dipped in hot coal tar, driven well home and cut off flush with the top of the sleeper.

23. Most railways use double-shouldered steel bearing plates which have a life comparable to the rail. No attempt is made to re-condition bearing plates. On light traffic lines with hardwood sleepers flat-footed rails are often laid directly on the sleepers. A few railways re-adze the bearing surface of the sleeper if the thickness of the sleeper allows but generally sleepers are discarded when the bearing plate seat becomes worn.

24. The most usual method of strengthening the ends of wooden sleepers is to use S. or C. clamps driven into the sleeper ends. A few lines bind the ends of the sleepers with wire or steel strips while others do not attempt any strengthening. The Pennsylvania Railroad considers the dowelling of the sleepers near the top and bottom at each end most effective but rather more expensive. Experience appears to indicate that little nett benefit is derived from any of these measures.

25. On sections where bearing plates are not used on the straight some railways provide them on curves. The usual method of preventing the spread of rails on curves is to provide extra coach screws and dog-spikes but the method adopted varies. The Pennsylvania Railroad provides an additional spike on the inside of the rail (on the straight the practice is one on each side) while the Victorian and Indian Railways add a spike to the outside of the outer rail. The minimum radius of curve for which additional spiking is provided varies from 5 730 ft. on the Pennsylvania Railroad, 1 650 ft. on the Victorian Railways, 1 150 ft. on the Indian Railways and 1 056 ft. on the South African Railways.

b) *Metal sleepers.*

26. Railways using steel sleepers usually re-press them when they are damaged and the rail seat and lugs are still in good condition. Most railways discard worn out sleepers but the Nizam's Railway, when the condition of the sleeper so justifies, repairs the rail seat and lugs by welding and re-pressing. The East African Railways, when the lugs are split, press the lugged sleepers and reform them as slotted sleepers.

c) *Concrete sleepers.*

27. Only a few railways report the use of concrete sleepers for experimental purposes and in these cases no repairs, except the replacement of fittings, have been carried out.

C. *Maintenance of level and curvature.*

28. Tamping by beater is still the most common method of packing sleepers but there is evidence of a gradual change to mechanical methods in the more advanced countries. Mechanical tampers are in use for stone ballast on the Pennsylvania Railroad, on British Railways (especially at crossings where there is limited space between the timbers) and on the Victorian Railways. This step has been taken to save labour and improve compaction. Measured shovel packing is used on British Railways and the South African Railways; as it is based on measurement it enables the track to stand up longer without attention.

29. All railways used the « string-lining » method to maintain correct curvature and to secure improvements. When curves are corrected permanent beacons are usually installed so that the correct curvature can be maintained. The East African Railways use a track recording machine which passes over the line at regular intervals. The small scale record of the versines readily shows where improvements are necessary. The Victorian Railways are considering the purchase of a versine-recording machine.

D. *Maintenance of the ballast and the bed.*

30. Practically all the reporting railways clean ballast by hand tools, ballast forks and screens, the ballast after cleaning being forked back into the track. British Railways sometimes use mechanical riddles instead of screens. Victorian Railways are considering the adopting of mechanical ballast cleaning equipment. The Pennsylvania Railroad always cleans the ballast in the shoulders and between tracks by mechanical ballast cleaning machines; between the sleepers the ballast is either cleaned by hand or removed entirely by crib cleaning machines, cleaned and returned to the track, The Sudan Railways use only earth ballast and no cleaning is necessary.

31. The Pennsylvania Railroad and British Railways use « Atlacide » (basic constituents sodium chlorate and calcium chloride) extensively as a weed killer; trials have been made with other commercial products. Dilutions of from 3 to 1 to 5 to 1 are normally used. The weed killer is sprayed from a train, trolley or by hand, one gallon of 5 to 1 solution covering about 20 square yards. Spraying is usually done once per year, before seeding occurs, though a run later in the year is found to be beneficial. Victorian Railways use calcium chlorate which is prepared as a

concentrated solution (2 lbs. of calcium chlorate to one gallon of water) at the depot. In the field this is further diluted by mixing 35 gallons of the solution with 65 gallons of water and applied as a spray from a trolley. The rate of application varies from 23 square yards to 35 square yards per gallon, depending on the weed growth. Where the tracks are securely fenced and away from water courses and station yards the Victorian Railways use the toxic sodium arsenite; in its liquid form 8 gallons are mixed with 390 gallons of water and it is applied as a drench from a trolley at the rate of one gallon to 4 square yards. All the other reporting railways weed by hand. The Pennsylvania Railroad also uses a « weed-burner » while British Railways use a mechanical weeder on the cesses.

Drawing up maintenance programmes and checking their carrying out.

32. In general most railway control their maintenance programme through the budget. Within its limitations the track supervisors draw up detailed programmes for the approval of the Engineer. The work performed monthly and the expenditure thereon is recorded for the use of supervisory officers. Charts are not usually maintained but on the Pennsylvania Railroad straight line progress diagrams are maintained by the Division Engineer (who supplies copies to the supervisor of each sub-division). The Chief Engineer maintains a record for the whole system; this permanent record indicates the annual programme in quantities and the amount of work completed each month. Practically all railways run recording equipment over their lines at intervals; the results are sent to the supervisory staff concerned so that all recorded defects can be rectified.

Tolerances allowed in the main dimensions of the material and in the constitution of the track.

33. Practices regarding the permitted wear of rails vary greatly both as regards the amount of wear and the basis on which it is measured. On secondary lines British Railways allow a total wear of 10 %, Indian Railways 7.7 % and South African Railways 14 % (8 1/2 lb. on a 60 lb. rail) for crown wear and 8.3 % (5 lb. on a 60 lb. rail) for side wear. The Sudan Railways allow 1/4 in. vertical wear and 3/16 in. lateral wear on 50 lb. rail and 3/8 in. both vertically and laterally for 80 lb. rail, while the East African Railways have so far found it necessary to specify limits for lateral wear only 11/16 in. for 50 lb. rail and 3/4 in. for 80 lb. rail. Victorian Railways and the Pennsylvania Railroad have no specific limits; various standards are set depending on the importance of the line and the material available for replacement.

No specific standard is usually set for the thickness of sleepers before they are replaced. A decision is usually left to the supervisor though some railways specify that sleepers should be transferred to sidings when rail-cutting reaches about one inch.

Practice regarding the tolerances allowed in the gauge of track varies a good deal. Wide gauge is permitted to the extent of 3/16 in. to 1/2 in. on straight track. Most railways do not permit track to be tight to gauge but a few allow tight gauge by varying amounts up to 1/2 in. All railways allow widening of the gauge on curves up to a maximum of 3/4 in.

Tolerances are not generally specified for variations in the level of the track. On the Pennsylvania Railroad where speeds are 70 m. p. h. or less, the maximum variation allowed is 3/4 in. between two points 62 ft. apart.

III. Modernisation of the equipment.

A. *Mechanical tools and appliances used in the maintenance of the rails and fishplates.*

34. The ratchet drill with brace and the manually operated drilling machine are still employed by all railways. In the more advanced countries mechanical drills are used in addition to hand drills; they are

usually driven by petrol engines but British Railways also use electric drills operating from a portable generator while Victorian Railways use compressed air. The time taken by power drills varies from one-fifth to one-half of the time taken to drill by hand. Power drillings enable the labour to be reduced by half.

35. Cutting of rails by hand saw is still practised by all railways. The Pennsylvania Railroad and the British Railways also use saws driven by petrol engines. On the former system little saving is effected in time or labour but the power saw gives a much more accurate cut, while on British Railways the time taken has been reduced from 20 min. by hand to about 10 min.

36. Most railways use screw - operated manual creep pullers. Compared with the old method of using bars, railways have been able to reduce the number of men required for this operation by varying amounts up to 50 %.

37. Of the reporting railways only the Pennsylvania Railroad and Victorian Railways report the use of power-operated equipment to tighten bolts. On the former system wrenches driven by petrol engines require three men to operate them but output per man is increased by 500 %. Victorian Railways sometimes use a compressed air bolt tightening machine.

38. Welding of joints « in situ » is not practised normally. Practically all railways build up worn frogs by the oxy-acetylene blowpipe using an excess acetylene flame. The deposited metal is forged by hand hammers. On the Indian Railways the time taken to complete one crossing, including grinding, is about six hours. Electric welding is also used. The building-up of rail ends is practised to a lesser extent.

B. *Mechanical tools and appliances used to maintain the sleepers and their fastenings.*

39. The drilling of holes in timber sleepers for dog-spikes or coach screws is still usually done by hand. The Pennsylvania Railroad is now using a petrol engine driven by borer which can be operated by one man and can drill a hole in four seconds. The type in use by British Railways requires two men for its operation.

40. The driving and removal of coach screws are usually done manually. Only the Victorian Railways report the use of power equipment; on that system compressed air apparatus is used. The Pennsylvania Railroad uses power - operated spike hammers and spike pullers for dealing with dog-spikes.

41. Portable power operated adzing machines are used on the Pennsylvania Railroad and Victorian Railways. To use these machines the rail and bearing plate must be removed so that their use is limited to rail-laying or extensive overhaul of the track. On British Railways all adzing is done at the depots. All other railways report the use of manual methods only.

42. S. and C. clamps, as anti-splitting devices, are applied by hand tools. Hand operated machines have been used to bind sleepers in the track with wire or metal strips but no railway reports their regular use.

C. *Tools and appliances used to rectify the level and curvature.*

43. The hand operated screw or ratchet type track jack (capacity 5 t or 10 t) is the usual means of raising track. The Pennsylvania Railroad reports the use of a power jack, driven by a petrol engine, in conjunction with some of the mechanical tamping machines. This power jack requires three men for its operation and in a normal raising operation will replace about three men.

44. The Pennsylvania Railroad, British Railways and Victorian Railways report the use of sleeper tamping equipment; other reporting railways tamp exclusively by hand. Various types are used on the Pennsylvania Railroad depending on quantity of track to be raised, type of ballast and

the traffic density. The most usual type is the air compressor with pneumatic tamping guns but unit tamping guns driven electrically or by a petrol engine are also in use. British Railways and Victorian Railways use « Matisa » tampers for plain track while the former use « Kango E » electric tampers for crossing work and also « Barco » (petrol engined) tampers.

46. Only the East African Railways report the use of a versine recording machine. This was developed by one of the Railways' engineers (R. C. Gowthorpe). In addition to measuring versines it records the state of the cross levels and running top of the track. Originally this track recorder was fitted, when required, to the frames of articulated locomotives as shown

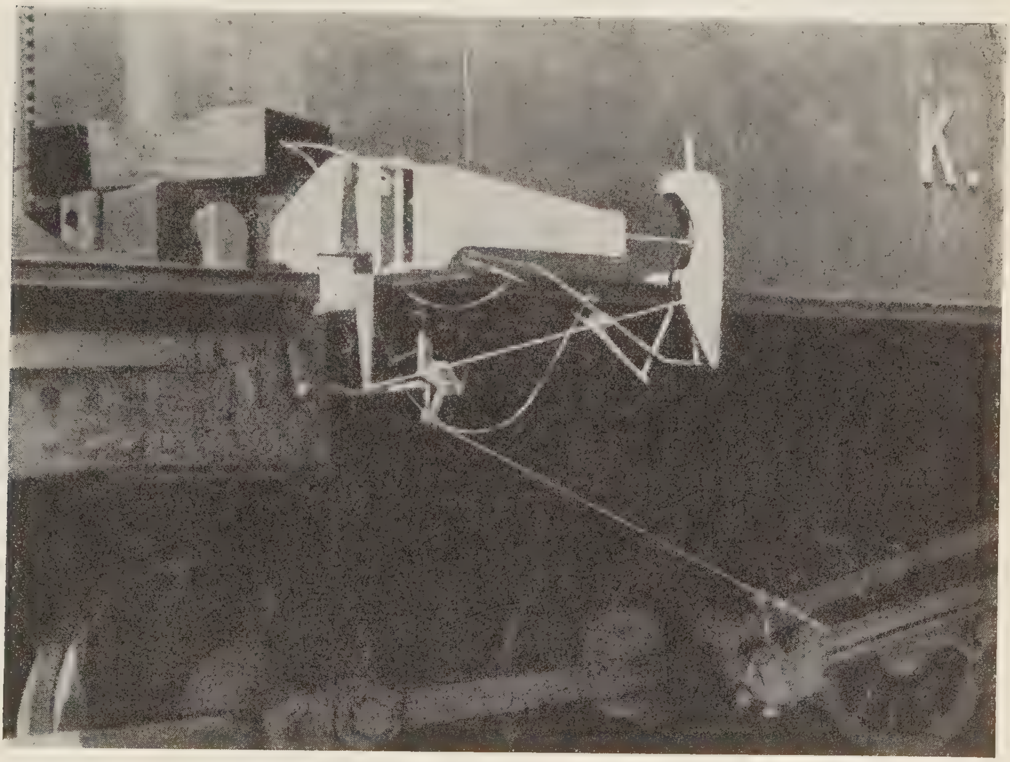


Fig. 1.

in Fig. No. 1 but subsequently a special articulated bogie vehicle was made, into which the machine was fitted and in which the operator and his assistants travel (Fig. No. 2). The distance between outer bogies of this vehicle is 40′ 7″ and the track recorded by the versine pen is a continuous series of versines on a chord of the above length, the scale being ap-

45. Railways practising measured shovel packing use the « Abtus » measured packing equipment (manual). No power-driven equipment is used for shovel packing though the Pennsylvania Railroad reports the use of electrically operated tamping machines which vibrate the ballast; these are particularly useful with gravel or cinder ballast.

proximately 5/64″ per degree of curvature (one degree curve radius = 5 730 ft.; two degrees = 2 865 ft., etc.); absolute accuracy is not claimed on account of the tolerance between the flanges of wheels and the gauge face of the rails. The track recorder vehicle is run over sections of the line at regular intervals and the diagrams obtained are submitted to the engineers concerned. By this means faults are eradicated and standards of track maintenance established. The recording pens are shown on the left of Fig. No. 3 and the drive mechanism and part of the recording apparatus on the right. A typical record of a length of track is shown in Fig. No. 4.

Fig. 2.

D. *Tools and appliances used in the upkeep of the ballast and bed.*

47. The Pennsylvania Railroad sprays weed killer from a car on the track; it is designed to spray the shoulders and ditches. British Railways use the following methods :

« *a*) Weedkilling trains, each usually consisting of locomotive, locomotive tender for mixing the weedkilling solution and fitted with spraying apparatus operated by steam pumps, one or two spare water tenders, a tank of « Atlacide » solution, a camp coach for the crew and a brake van.

b) Trolley apparatus. 50 gallon tank mounted on platelayer's trolley fitted with sprayers and pump driven off one axle, the whole being propelled by motor driven Permanent Way Trolley.

c) Chipman weed-sprayers — two wheeled mobile spraying unit comprising 25 gallon tank and pressure pump driven by small petrol engine. »

Victorian Railways spray from motor trollies and also use knapsack hand spray pumps.

48. British Railways use « Gem » rotary hoes and « Colwood » cess hoes. No other reporting railway uses mechanical weeders but the Pennsylvania Railroad uses an on-the-track weed-burner. The machine has five burner units, two on each side of the track and one in the centre, designed to burn the grass and weeds on the ditch line, the shoulder and the centre.

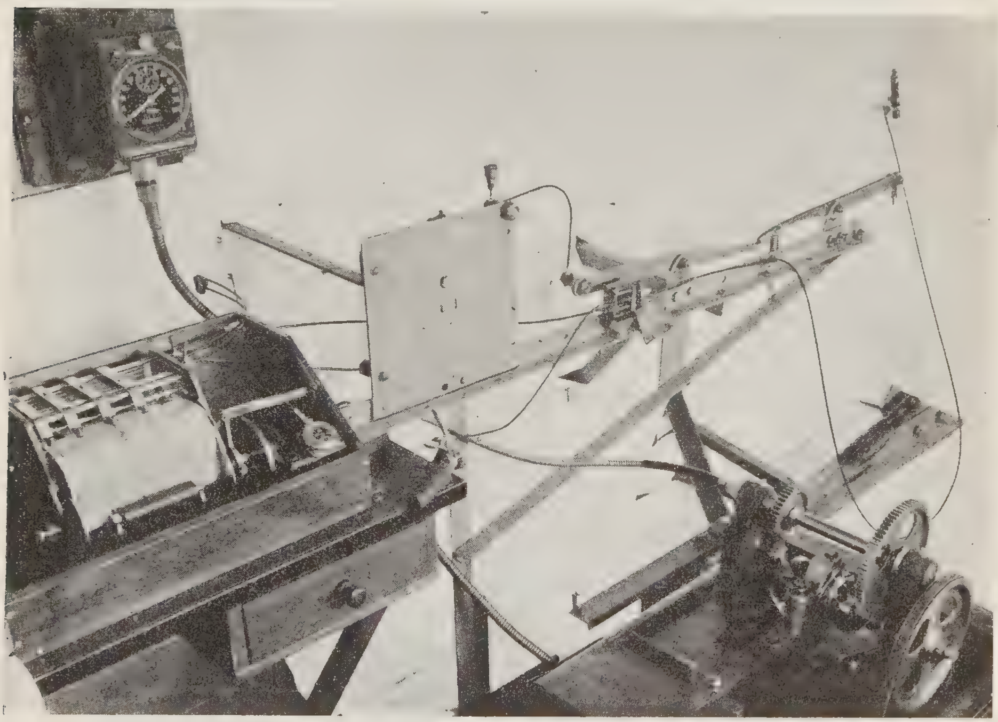


Fig. 3.

49. Hand tools — ballast forks, hand sieves and screens — form the usual equipment for cleaning ballast. In place of screens British Railways also use the « Abtus » ballast riddle consisting of a small vibrating screen driven by a petrol engine. The Pennsylvania Railroad is the only reporting system using large mechanical units. For cleaning the shoulders and the ballast between track the « Mole » and Brownhoist machines are principally used. The Mole is an off-track machine which digs the ballast, shakes it, disposes of the dirt and returns the clean ballast. The Brownhoist is an on-track machine which removes the ballast by means of an endless bucket conveyor, shakes it, returns the clean ballast and either loads the dirt into cars or disposes of it off the formation.

50. Practically all the reporting railways are examining closely the possibility of mechanising some of the processes. Apart from those already mentioned the Pennsylvania Railroad reports the regular use of a mechanical cribbing machine which pulls out the dirty ballast from the space between the sleepers and deposits it on the shoulder or between tracks where the ballast can be cleaned by the Mole or Brownhoist.

Organisation of working sites using mechanical appliances :

51. Of the reporting railways only the Pennsylvania Railroad was able to give details of the organisation using mechanical appliances to the greatest possible extent. That system has provided the following outline of a rail laying operation :— (see Table next page.)

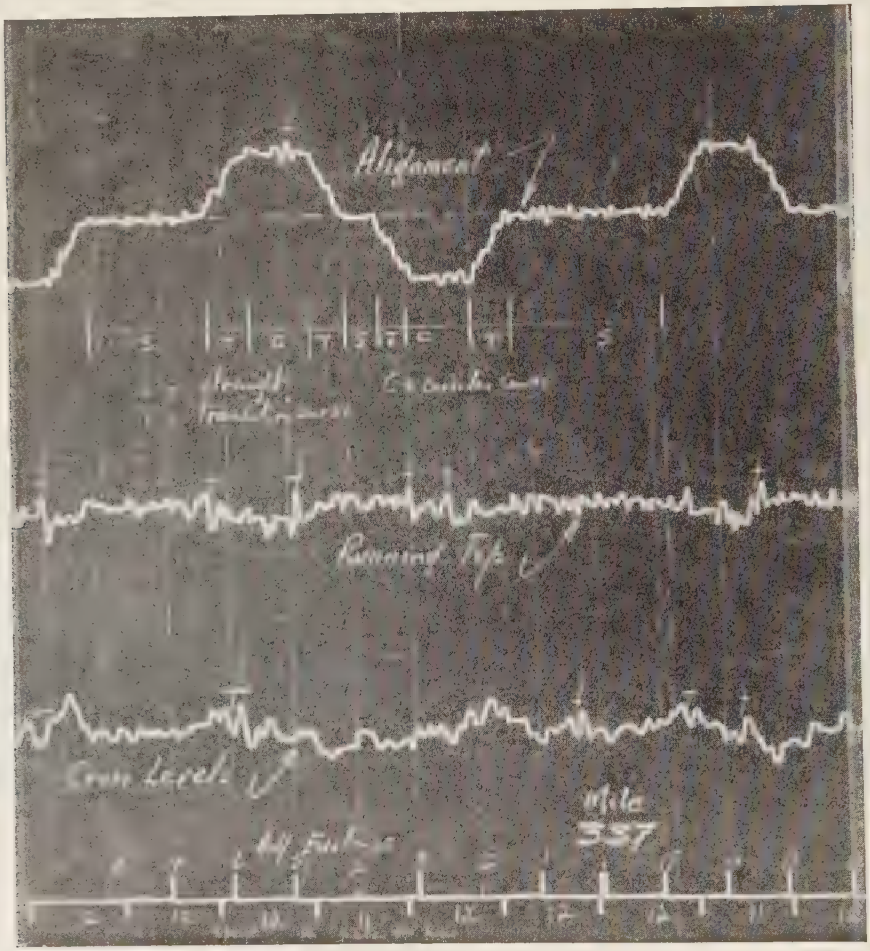


Fig. 4.

IV. Results obtained.

From the technical point of view on the quality of work.

52. The adoption by some railways of longer sections with gangs made mobile by trollies or buses has enabled manpower to be utilised to the best advantage. It ensures adequate strength at any point though the average standard of the track is probably not improved.

	No. of men without use of machines	No. of men required using machines or devices	Decrease in men required	Name of machine used	No. of units used
Pulling Jt. Spikes	1	1	—	—	—
Removing bolts	15	1	14	Nutter	1
Removing rail anchors	1	1	—	—	—
Distribute tie plates	2	2	—	—	—
Pull spikes	30	7	23	Spike Puller	3
Removing frozen bolts	2	1	1	Oxy-Acetylene cutting torch	1
Removing joint bars	1	1	—	—	—
Roll out old rail	2	2	—	—	—
Remove old tie plates and scrap	4	4	—	—	—
Cribbing	10	4	6	Power cribber	2
Sweep ties	1	1	—	—	—
Place and drive tie plugs	8	8	—	—	—
Drive spike stubs	4	4	—	—	—
Adze ties	20	4	16	Adzer	3
Apply creosote to adzed ties	2	2	—	—	—
Place tie plates	4	4	—	—	—
Gage tie plates	5	1	4	Tie plate gager	1
Set in new rail	20	4	16	Burro crane	1
Grind adze bits (1)	—	1	—	Tool grinder	—
Grease rail ends	1	1	—	—	—
Distribute O.T.M.	2	2	—	—	—
Apply joint bars	6	6	—	—	—
Drill holes in cut rails	4	1	3	Power drill	1
Tighten bolts	10	2	8	Nutter	1
Gage rail	10	10	—	—	—
Bore ties (1)	—	2	—	Tie borer	2
Set spikes (1)	—	6	—	—	—
Drive spikes	30	8	22	Air compressor Spike hammers	2 5
Apply rail anchors	3	3	—	—	—
	198	94			

Total men without use of machines or devices . . 198
Total men with use of machines and devices . . . 94

Total men saved 104

(1) These operations would not be performed without machines.

The above totals do not include any supervision, such as foreman, etc.

The adoption of new methods is tending to raise the standards of the track. The more systematic the organisation becomes the better the condition of the track.

The quality of the work produced by mechanical methods is generally superior to work done by hand at the present time though the machines have primarily been adopted as labour saving devices and as aids to manpower. The principal drawback on those railways which have reached an advanced stage of mechanisation is that as trackmen become accustomed to use machines they are less willing to do the work manually when no machine is available. A second drawback is that, as it is not economically possible to equip each gang with all the machines required during a season, it is necessary to plan the work much more closely so that the maximum use is obtained from the equipment. A third drawback is the necessity for well trained operators and an adequate plant maintenance organisation.

From the economic point of view in the output of work.

53. Revision in the composition of the gangs has not generally resulted in higher output per worker though on light traffic lines it has enabled an adequate standard to be maintained with the smallest possible labour force.

It is difficult to estimate with any precision the extent to which new methods have increased output, especially as new methods are often associated with the introduction of mechanical equipment.

The re-laying organisation of the Pennsylvania Railroad, as described earlier, shows the considerable economy (a reduction of more than 50 % in labour) which can be achieved by organising the work to take full advantage of mechanical equipment. The full use can be made of heavy mechanical equipment only if full occupation of the track can be obtained; this is possible only with double and multiple track. On single track it will often be necessary to use off-track equipment. The experience of the Pennsylvania Railroad shows clearly the economic benefits to be derived from small units, e.g. with the nutter three men can tighten bolts on one to one and a half miles while the same men could scarcely tighten half a mile by hand, and with the small sleeper tamping units a section gang can double its output.

From the social point of view.

54. Where large and mobile gangs replace smaller section gangs on light traffic lines it is usually possible to locate the gangs at less isolated points and so give the men and their families a fuller social life.

Changes in organisation have not been on a scale to make any great difference to the men from a social point of view.

The introduction of mechanical equipment is not always popular but in the end is usually welcomed both by the men and their supervisors. The use of machines is increasing the number of specialists required and these can generally aspire to a higher wage rate. The use of machines makes the work less fatiguing but in doing this it creates a reluctance in the men to perform the work by hand when machines are not available. It is doubtful if the introduction of machines gives the men a greater interest in their work.

55. As would be expected the greatest progress in modern methods has been achieved in the more advanced countries, North America, Europe and Australia. All reporting railways are studying new developments closely with a view to adopting those which can be shown to be advantageous in their particular circumstances.

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OFFICIAL INFORMATION

ISSUED BY THE

PERMANENT COMMISSION

OF THE

International Railway Congress Association.

Meeting of the Permanent Commission, held on February 25, 1950

The Permanent Commission of the International Railway Congress Association held a meeting on the 25th February 1950 in the Belgian National Railways' Headquarter Offices at Brussels.

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Mr. DELORY, *President*, opening the meeting adressed a warm welcome to the personalities present.

He then requested the Meeting to approve the Minutes of the meetings held on the 1st and 4th June, 1949.

Mr. GHILAIN, *Vice-President and General Secretary*, informed the Meeting of the changes made in the Permanent Commission since the last meeting and of the steps taken to fill vacant mandates.

The Meeting approved the nomination of the following personalities as members of the Permanent Commission :

Dr. HUYBERECHTS, Deputy Director General of the Belgian National Railways as successor to Mr. G. WILLAERT, retired.

Mr. R.A. RIDDLES, Member of the « Railway Executive », British Railways, as successor to Mr. O. V. BULLEID retired.

Mr. CSANADI, Director General of the Hungarian State Railways, as successor to Mr. L. VARGA, retired.

Mr. Ugo VALLECCHI, Director General of the « Inspectorat Général de la Motorisation Civile et des Transports » of the Italian Ministry of Transport, as successor to Dr. Eng. E. MELLINI, retired.

On the proposal of five members, the Meeting unanimously decided that Mr. BOUTET, who had ceased to be Vice-President of the Administrative Council of the S.N.C.F., should retain his mandate until after the Rome Session.

On the other hand, the mandate of Mr. E. ALFONSO, who had ceased to occupy the position of President of the Administrative Council of the Spanish National Railways, had expired and his successor was still to be appointed.

* * *

The GENERAL SECRETARY informed the Meeting of a request for a seat on the Permanent Commission received from the « Irish Transport Company », which had recently resumed membership to our Association, according to § 5 of

article 6 of our Rules and Regulations, the Executive Committee proposed the creation of a new mandate which would be granted to the Republic of Ireland.

This proposal, together with the nomination of the delegate proposed by the Irish Railways : Mr. T.C. COURTNEY, Director General of Coras Iompair Eireann (Irish Transport Company) was adopted.

* * *

The GENERAL SECRETARY then informed the Meeting of the various steps taken for the organisation of the Rome Congress, which will be held at the Arts School of the Rome University, from the *25th September to the 4th October 1950.*

With regard to travel facilities, all delegates will receive prior to their departure for the Congress, a membership card which will be used as a free pass to travel to Rome, for themselves and the ladies accompanying, whose names have been entered.

Further, the delegates and the ladies (the latter with a special card) will be entitled to free transport on the Italian State Railways, from the 8th September to 24th October, 1950. This card will also constitute a free pass available on local railways, trams, busses and inland waterways navigation lines.

According to custom, the principal Italian and foreign technical publications and some daily newspapers will be invited to send a correspondent to the Rome Congress. As on former occasions, members of the press will be authorised to be present at plenary sessions and at the principal receptions.

The Meeting was then informed as to the point reached in the preparatory work for the Rome Congress. The majority of reports to be published for discussions in sections had been received by the Secretariat and their publication in the monthly *Bulletin* (French and English editions) started in February 1950. Despite the short time available all was being done to ensure that the work would be completed on the date fixed and that all reports would be distributed to members before their departure for Rome.

Numerous member Administrations and several Governments have already sent to the Secretariat a list of their delegates at the Rome Congress and everything seems to indicate, at the time of meeting of the Permanent Commission, that this Session will see a large number of delegates present.

Mr. DI RAIMONDO, President of the Italian Organizing Commission of the Rome Congress, then gave information as regards the activity of this Commission and stated, in particular, that a detailed programme of meetings, receptions, technical and other excursions, together with a list of hotels, would be sent without delay to all delegates. A Sub-Commission, presided by Mr. LALONI had been entrusted with the task of settling questions regarding excursions during and after the Session. In conclusion, Mr. DI RAIMONDO assured the Meeting that the Local Commission would spare no effort in making the stay of the participants as pleasant as possible.

The Meeting then examined the Agenda for the Congress (Monday 25th September to Wednesday 4th October) and particularly the dates and times on which

plenary sessions and meetings of sections would be held.

The names of the members of the Bureau of the Rome Session were also announced.

The Italian Minister for Transport had kindly accepted the Honorary Presidency, the Honorary Vice-Presidencies being reserved for the Under-Secretaries of State. A proposal will be made to elect as President : Mr. G. di Raimondo, Director General of the Italian State Railways, and Vice-Presidents : Mr. Ferruccio Marin and Mr. Ettore Lo Gigno, Vice-Directors General of the Italian State Railways and Mr. Ugo Vallecchi, Director General of the « Inspectorat Général de la Motorisation Civile et des Transports concédés ».

A decision was also taken as regards the allocation between the various nationalities of the presidencies and vice-presidencies of the five sections and as regards also the nominations of the deputy general secretaries and principal secretaries.

Finally, the Meeting nominated the special reporters, who would be entrusted the task of summarising the various reports on a same question in view of the discussions to take place at the Rome Congress.

***

In conformity with article 6 of the Rules and Regulations of the Association, one third of the mandates of the Members of the Permanent Commission are renewable at each Congress and retiring Members are re-eligible.

Twenty-two members are affected by this rulling and, according to precedent, it has been decided to invite them to accept renewal of their mandate which expires at the 15th Session. The nominations will be made at the first meeting of the Permanent Commission to be held in Rome. *(See list hereafter.)*

***

The General Secretary recalled the suggestion made at the Meeting held in Lisbon in June 1949, that a supplement to the *Bulletin* should be published to cover solely electric traction. It had been decided at that time to carry out an inquiry among the various member Railway Administrations in order to ascertain whether such a supplement was opportune. Results of this inquiry showed a large majority in favour of this development.

The creation of this supplement to the *Bulletin* was therefore definitely adopted.

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The statement of receipts and expenditures for the year 1949 was approved by the Meeting as well as the provisional budget drawn up for the year 1950. As a result, to cover estimated expenditures, the Meeting decided that the rate of the variable part of the yearly contribution for 1950 will be 0.18 gold-franc per kilometre; the maximum fixed in the Rules and Regulations being 1/3 gold-franc per kilomètre.

***

The Meeting took note of the various changes in membership since the Meeting on the 1st June 1949.

Four Railway Administrations have requested membership :

Malayan Railways	1 384 km (863 miles)
Coras Iompair Eireann . .	3 212 km (1 990 miles)
Rhodesian Railways . . .	4 022 km (2 486 miles)
Chemins de fer de l'Etat Syrien (Lignes du Nord)	248 km (154 miles)

The Railway Congress Association at present includes 34 Governments, 8 Organisations and 103 Administrations with a total mileage of approximately 450 000 km (280 000 miles).

The Meeting noted further a request received from the Administration of the Japanese Railways and the present talks with the German Railways (Western Zone) with a view to their resuming membership of the Association. These questions are at present before the members of the Permanent Commission.

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Finally, the Meeting dealt with various questions regarding the activities of the Association since the last meeting of the Permanent Commission.

At the end of the Meeting, Mr. DELORY President of the Association recalled that the present meeting had coincided with the 25th anniversary of Mr. GHILAIN's nomination as General Secretary of the Association.

The PRESIDENT, after having praised the high qualities which Mr. GHILAIN had shown at this task during that period. which had been marked by several large Congresses and enlarged meetings of the Permanent Commission, made a presentation to Mr. GHILAIN on behalf of the Permanent Commission.

Mr. GHILAIN expressed his thanks in very moved terms, associating his predecessors as well as his collaborators to the success of the Sessions, which had been recalled.

— The Meeting then closed.

The General Secretary, P. GHILAIN.

The President, F.H. DELORY.

List of Members of the Permanent Commission

OF THE

INTERNATIONAL RAILWAY CONGRESS ASSOCIATION

(25 February 1950.)

President :

F. H. **Delory** (1), directeur général de la Société Nationale des Chemins de fer belges; 19, rue du Beau-Site, Bruxelles.

Vice-presidents :

Goursat (2), directeur de la Région du Nord de la Société Nationale des Chemins de fer français; 18, rue de Dunkerque, Paris (X^e^);

P. **Ghilain** (3), directeur du Service du Matériel et des Achats de la Société Nationale des Chemins de fer belges; 19, rue du Beau-Site, Bruxelles.

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Dorges (1), inspecteur général des Ponts et Chaussées, secrétaire général aux Travaux publics, directeur général des Chemins de fer et des Transports au Ministère des Travaux publics et des Transports; 244, boulevard Saint-Germain, Paris;

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Sir Gilmour **Jenkins** (3), Secretary to Minister of Transport (Great-Britain); Berkeley Square House, Berkeley Square, London, W. 1.

Ex-presidents of session, members ex-officio :

S. E. Ibrahim Fahmy **Kerim** Pacha; Le Caire.

D^r^ W. **Meile,** ancien président de la Direction générale des Chemins de fer fédéraux suisses; Berne.

Members :

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Armand (1), directeur général de la Société Nationale des Chemins de fer français; 88, rue St-Lazare, Paris (IX^e^);

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T. C. **Courtney**, Chairman of the Coras Iompair Eireann, Kingsbridge Station, Dublin;

Csanadi (2), Directeur Général des Chemins de fer de l'Etat hongrois; Budapest;

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(1) Retires at the 15th session.
(2) Retires at the 16th session.
(3) Retires at the 17th session.

R. **da Costa Couvreur** (2), ancien président du Conseil supérieur des Travaux publics au Ministère des Travaux publics et des Communications du Portugal; Almada das Linhas de Torres, 145, Lisbonne;

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Dorges (already named).;

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P. **Ghilain** (already named);

Goursat (already named);

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Sir Gilmour **Jenkins** (already named);

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Ing. F. **Marin** (1), vice-directeur général des Chemins de fer de l'Etat italien; Rome;

Ing. P. P. **Martin** (2), inspecteur général de l'Exploitation commerciale, sous-directeur des Chemins de fer de l'Etat argentin; Buenos-Aires;

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(1) Retires at the 15th session.
(2) Retires at the 16th session.
(3) Retires at the 17th session.

J. H. **Nuelle** (1), president, Delaware & Hudson Railroad Corporation; 32, Nassau Street, New York City;

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F. Perez **Villamil** (3), sous-directeur général du Réseau National des Chemins de fer espagnols; Madrid;

Wagner (2), ingénieur en chef au Ministère des Communications de Pologne; Varsovie;

S. E. le Dr Sayed Abdel **Wahed** Bey (1), directeur général à l'Administration des Chemins de fer, Télégraphes et Téléphones de l'Etat égyptien; Le Caire;

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N... (1), Austria;

N... (2), Spain.

Honorary member : U. **Lamalle,** directeur général honoraire de la Société Nationale des Chemins de fer belges, professeur de cours de chemins de fer à l'Université de Louvain; 175, avenue Winston Churchill, Uccle-Bruxelles.

Temporary Members of the Permanent Commission (Members of the Executive Committee of the Italian Local Organizing Commission of the Rome Congress, 1950) :

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Avocat Genaro **Barra,** président de l'Association Italienne des Hôteliers; Via Barberini, 47, Rome;

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(1) Retires at the 15th session.
(2) Retires at the 16th session.
(3) Retires at the 17th session.

Sigfrido **Ciccotti,** chef du Bureau de Presse du Cabinet du Ministre des Transports; Piazza della Croce Rossa, Rome;

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Rag. Enrico **Linzi,** directeur général de la Compagnie italienne de Tourisme; Piazza Esedra, 68, Rome;

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S. E. le Prince D[r] Don Francesco **Massimo Lancellotti,** président du Syndicat provincial pour le Tourisme de Rome; Via Barberini, 47, Rome;

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